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DEVELOPING NATIONAL ENVIRONMENTAL STANDARDS FOR AFRICA

Based on a mission report prepared by
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For technical reasons, this report has not yet been formally edited, and the French version is not yet ready because of its volume.

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PREFACE

This ECA/ARSO Report on "Developing National Environmental Standards for Africa" is based on a consultant's mission report prepared by Dr. Fletcher Banda, Director, Malawi Bureau of Standards, Blantyre, Malawi, in May 1985. The consultant's report was discussed at an ECA/ARSO Expert Group Meeting on the Establishment and/or Improvement of National Standards for the Protection of the African Environment (First Meeting of ARSO/TC.9), held at ECA, Addis Ababa, 10-14 June 1985. The Report of the ECA/ARSO Expert Group Meeting (document E/ECA/ENV/20) is being presented to the Third Meeting of the Joint Intergovernmental Regional Committee on Human Settlements and Environment to be held at ECA, Addis Ababa, from 22 to 26 July 1985.

This ECA/ARSO Report on Developing National Environmental Standards in Africa (E/ECA/ENV/17) is a supporting document to the above mentioned report of the ECA/ARSO Expert Group Meeting, both of which will be distributed to all ECA member States when all the completed questionnaires are received and analysed.

ACKNOWLEDGEMENT

The writer would like to thank the many people he met during the study mission who contributed significantly in the preparation of the report, whose names are recorded in Annex I.

In particular he would like to thank the Ethiopian Standards Institution (ESI), the Egyptian Organization for Standandardization (EOS), the Ministry of Industry and Technology of Zimbabwe and the Malawi Bureau of Standards (MBS) for organizing local visits in their respective countries at short notice. He would like to express special thanks to Mrs. Fettlework Ketsela of ESI, Mr. A.S. Khulumula of MBS and Mr. Maher Atteyia of EOS for accompanying him throughout the visits in Ethiopia, Malawi and Egypt, respectively.

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CHAPTER I

STATE-OF-THE-ART ON ENVIRONMENTAL STANDARDS IN AFRICAN COUNTRIES

A. Background to the study

1. It will be recalled that the African Regional Organization for Standardization (ARSO) was formed by the United Nations Economic Commission for Africa (UNECA) in 1977 to develop regional standards for their subsequent application by member States to various sectors of development. ARSO promotes the integrated approach to standardization by advocating combined operations of activities in standards formulation, quality control, certification marking, inspection and testing, metrology and documentation. Since then ARSO has established eight technical committees whose membership are drawn from the ECA member States, to elaborate African Regional Standards.

2. It is the policy of the ECA to assist member States of the Africa region in developing environmental capabilities and machineries that would handle the issues of environmental concern in the exploitation of their resources for social and economic development. It is, therefore, the intention of the ECA to work in close collaboration with member States in developing standards for the protection of the environment such that these can be incorporated in their legislative and law enforcement infrastructure for sound cost-benefit and cost-effective environmental management.

3. To this end, the areas of immediate concern that will create a basis for activity are: water, air pollution and ecological degradation. When standards are developed in these areas, it will be possible to initiate procedures for establishing those legislative structures that ensure their implementation.

4. The ECA is collaborating with the African Regional Organization for Standardization (ARSO) located in Nairobi, Kenya, for the implementation of a programme element in its Environment in Africa Work Programme for the 1984-1985 biennium. The outputs of the programme element 1.1 are as follows:

(a) Report to the Joint Intergovernmental Regional Committee on Human Settlements and Environment on developing guidelines for the establishment or improvement of national institutions to assess, monitor, control environmental degradation in Africa, including the settling up of national standards; and

(b) Substantive servicing of an Expert Group meeting on establishing or improving national standards for the protection of the African environment.

5. The legislative authority from the ECA and ARSO to establish the ECA/ARSO joint project to conduct this mission study is derived from the following resolutions:

(a) ECA resolution 412 (XVI) of April 1981 - Development of environmental protection legislation in the ECA region;

(b) ECA resolution 496 (XIX) of May 1984 - Environment and Development Part II - Industrial environmental impact assessment;

(c) 5th ARSO Council Minute 7.3 (1980) - Approval of Rules Governing Technical Activities of ARSO (includes a mandate to develop regional standards in the field of environmental protection, sanitation and pollution control); and

(d) 10th ARSO Council Minute 10.5 (1984) - Approval of the Programme of Work and Budget for 1985 (includes an approval for the establishment of ARSO/TC 9 on Environmental Protection and Pollution Control.

Objectives

6. The long term objective of the ECA/ARSO joint project is to assist African Governments to develop national standardization and metrication for the protection of the environment in Africa during overall economic development.

7. The more immediate objectives are:

(a) to establish African regional standards for air pollution, water pollution, soil pollution and marine pollution by determining tolerable limits for the various pollutants for humans, animals and plants in the Africa region;

(b) to strengthen national infrastructure such as institutions, legislative measures and administrative machinery to identify, monitor, assess and control pollutants as well as various human activities causing environmental degradation in Africa.

8. The ECA/ARSO will jointly produce a document - Guidelines for the establishment or improvement of national standards for the protection of the African environment which will be finalized at the expert group meeting before submission to the ECA member States at the Intergovernmental meeting.

Terms of reference

9. The mission is expected to be conducted through ARSO technical focal points in the selected countries to be visited. Ministries responsible for environmental protection, for setting up national standards and their implementation in Ethiopia, Egypt, Zimbabwe and Malawi will be visited.

10. The mission is expected to accomplish the following tasks:

(a) Water pollution

(i) identifying the infrastructures that can handle laboratory experiments;

(ii) identify national institutions with these infrastructures;

(iii) identify types of industrial pollutants;

(iv) identify types of toxic effluents from each industrial activity;

(v) identify effluents that are likely to encourage eutrophication in water bodies and their potential danger to both land and aquatic fauna;

(vi) suggest possible tolerable standards or limits (maximum) for these pollutants; and

(vii) suggest possible legislative measures that should be taken to enforce these standards.

(b) Air pollution

(i) identify the type of air pollution that are prevalent in Africa;

(ii) identify the sources of air pollution and categorize these sources e.g. industrial emissions, motor vehicles emissions, etc;

(iii) determine tolerable limits for each pollutant for humans, animals, and ecological balance;

(iv) identify national institutions that can monitor these pollutants; and

(v) identify those legislative structures and measures that can be used to enforce these standards.

(c) Ecological degradation

(i) Agriculture: suggest possible guidelines or legislative measures that should be taken to control the use of fertilizers and pesticides;

(ii) Mining and development of minerals: suggest possible guidelines or legislative measures that should be taken to control and guide the mining and development of minerals operations;

(iii) Industry: suggest possible guidelines or legislative measures that may protect the water courses and other water bodies against effluent pollution.

Conduct of the study mission

11. This study mission was carried out during the period 9 March to 12 April, 1985, and included visits to ARSO (African Regional Organization for Standardization), technical focal points in the selected countries, ministries responsible for environmental protection and for setting up national standards in Ethiopia, Egypt, Zimbabwe and Malawi, as detailed in Annex I. Malawi was visited between 9 and 12 April, 1985, instead of Botswana which did not respond to request to receive the Consultant. Due to the limited time available, the consultant did not consult with institutions in the selected countries which deal with air, water and soil pollution by radiation from atomic energy and radioactivity.

12. Discussions were also held with ARSO officials, the officials of UNCHS-HABITAT, and UNEP - (GEMS) in Kenya. It was not possible to hold discussions with officials of the Environmental Section of the Social Development, Environment and Human Settlements Division of the United Nations Economic Commission for Africa in Addis Ababa, Ethiopia, as most of them were away on other pressing engagements.

13. A detailed analysis of the questionnaires that are returned to ARSO was supposed to be made to assist in preparing the Report. The questionnaire is as provided in Annex II. However, at the time the report was prepared, no returns had been received from ARSO focal points and ECA member States.

B. General analysis of prevailing situation in the region, future tronds and courses of action

14. Africa is the second largest land mass in the world, the largest being Eurasia, and is endowed with both renewable and non-renewable natural resources. Exploitation of the non-renewable resources started many centuries ago initially by explorers and later through colonialism and more recently through neo-colonialism. Very little regard has so far been given to air and water pollution, soil pollution and land degradation.

15. The historical past of Africa ranks among some of the oldest civilizations. For instance, Egypt, West Africa, East Africa and Southern Africa have a rich heritage of human interactions with their environment dating back, in some cases, hundreds of centuries. In these cases man has been engaged in activities that have changed the natural environment significantly into deserts. The Namib, Kalahari and Sahara deserts are such examples. Very little efforts were made to rehabilitate the land that no longer produced enough food. They simply moved to more virgin lands for agriculture and pasture and the process of deforestation continued.

Pollution of the African environment

16. The main focus on the state of the environment is the changes - positive and/or negative - that occur in the different natural environments (atmosphere, hydrosphere, lithosphere, etc.) with particular attention to the interacting processes between these components. These processes demonstrate the functional interrelationship between the non-living, or abiotic environment and the biotic community of plants, animals, and microbes that is fundamental to environmental dynamics as indicated in Figure I. Disruption of the relationships between the components of the natural environment could be attributed to natural or man-made factors.

Atmospheric pollution

17. Air that has sufficient oxygen for respiration, and is not contaminated with toxic substances, is vital for maintaining life. In this respect, the main risks to human health from inadequate oxygen supplies or polluted air arises from occupational hazards, where the air may be contaminated in a confined working space with poor ventilation. The outdoor atmosphere is seldom badly enough contaminated to cause health risks, except in certain industrialized and urban environments. Problems do arise, particularly for people with respiratory ailments, in areas with high sulphur dioxide, particulate materials and nitrogen oxide emissions.

18. Globally no atmospheric changes can be identified as a hazard to human health, except the increase in ultraviolet light caused by erosion of the ozone layer in the stratosphere by chlorofluorocarbons among other man-made emissions. However, certain atmospheric emissions must be recognized as having global impact. Carbon dioxide concentrations in the atmosphere have been increasing; the "green house effect" which is expected to give rise to higher global temperatures and possible climatic changes. Increasing particulate matter in the atmosphere from man-made emissions is expected to reduce the amount of incident solar radiation, and this is an area of concern which requires urgent scientific research to establish the effect of this on global temperatures and climate.

19. Over the past three decades African countries have opened up several mines, sunk dozens of oil wells, and set up several industrial firms aimed at exploiting non-renewable natural resources, and achieving a higher manufacturing value-added per capita in order to move towards self-reliance in food and industrial production. Mining operations involve quarrying and excavation of the earth - activities which cause land degradation, create dust and spoil-heaps from which dust can be blown. On the other hand the generation of power from fossil fuel such as coal and oil produces huge quantities of smoke and fumes and the smelting process produces fumes which pose occupational hazards to workers within confined areas in factories and pollution hazards to buildings, vegetations, rivers, and human as well as animal life.

20. Emissions emanating from industrial activities consist of pollutants classified into two main types:

(a) Aerosols - air borne particulates:

(i) dusts consisting of fly ash, cement, foundry shakeout dust;

(ii) smokes - carbon particulates (oil smokes, coal smoke);

(iii) mists - mist, fog; and

(iv) fumes - volatilised minerals, chemicals (organic and inorganic).

(b) Gaseous materials - gases and organic compounds:

(i) gases - sulphur dioxide, carbon dioxide, carbon monoxide, ammonia, hydrogen sulphide, hydrogen fluorides and chlorides, oxides of nitrogen; and

(ii) organic compounds boiling under 200°C such as, aldehydes, organic sulphides, organic halides, hydrocarbons, etc.

Industrial activity is increasing the concentration of metals like copper, nickel, and molybdenum but little is known about the risks of those people who now have to live and work in surroundings which expose them to potentially harmful doses of these and other metals. Scientists are actively engaged in research on the effects of metal contamination on ecosystems. One worrying information known is that, even very low copper concentrations can slow down the decomposition of forest litter and thus interfere with the biotic community interactions.

21. UNEP has set up a registry of potentially toxic chemicals and is also cooperating with the WHO in a programme to find out which pollutants are most dangerous to health. But much more research is urgently needed before anything like a complete picture is made of the effect of some toxic chemicals on the biotic community of plants, animals and microbes.

22. Although atmospheric pollution will continue to be a nuisance in most urban and industrial areas, other forms of pollution such as water pollution have the greatest impact on the lives of many people in Africa today.

Water pollution

23. Industrial activities have attracted, in several countries in Africa, people from the rural areas to the cities and industrial townships. The influx of people into urban and semi-urban areas has put severe strains on local authorities in providing the basic necessities of life such as shelter, piped water, sewage treatment systems and refuse disposal. On the other hand, several industries produce huge quantities of liquid effluent which is discharged into water bodies with little regard to the consequences the people who depend upon river water down stream may suffer. The siting of buildings within the catchment areas of rivers, the disposal of household garbage, and human excreta into river courses, constitute a potential source of pollution within settlements.

24. The oxides of sulphur and of nitrogen are not only harmful in themselves but also in combination with other substances. In moist air they turn into nitric acid or sulphuric acid that make water in rivers, lakes, etc. too acidic to support any biotic life or the soil too acidic to support vegetation including trees. Acid rain, precipitates of oxides of nitrogen and sulphur, is known to have been responsible for the death of many lakes and rivers in the Scandinavian countries and North America.

25. Due to the lack of adequate safe drinking water, sufficient rainfall for sustained agriculture and food production, and due to uneven distribution of water resources, and the pollution of surface water with human excreta, sewage, factory and industrial effluents, African countries have suffered from:

(a) environmental problems such as waterlogging, salination and eventual destruction of arable land;

(b) the spread of schistosomiasis and other water-related diseases;

(c) poisoning from agricultural fertilizers and pesticides due to contamination of surface waters; and

(d) widespread water-related public health diseases such as, diarrhoea, and enteric diseases, skin and eye infections resulting from insufficient domestic water supply and safe waste disposal.

Soil pollution

26. Industrial activities produce air pollutants and acids which are now entering forests at an unprecedented scale and rate. Acting alone or together, several pollutants - including acid-forming sulphates and nitrates, gaseous sulphur dioxide, ozone, and heavy metals - appear to place forests under severe stress in North America, Europe and even in some parts of Africa.

Scientists have not yet fully explained the process of forest destruction but the observation that acidic soils are hardly capable of sustaining forests for long is too strong to ignore the effect of acid rain. Trees under the conditions of acidic soils may lose their resistance to natural events such as droughts and insect attacks.

27. Pesticides, apart from being one of the most significant technological discovery of man, have posed serious health hazards to mankind and the environment. The biggest danger comes from those most stable pesticides which are non-biodegradable. They are found in the food chain affecting aquatic life, birds, animals and man. Pesticides like DDT can stay in plant or animal tissues for a long time because they cannot be broken down by natural processes. An alarming feature about pesticides is that no attempts are made to establish precisely their harmful effects to biota until after a great deal of damage has been done.

28. Collection of data on the toxicity and efficacy of the various pesticides would assist African states to decide which types of pesticides are useful. Since pesticides become hazardous to the environment by their formulation and also by methods of application, site, time and rate of application, scale of use, climatic conditions and geographical locality, it is necessary that steps should be taken to adequately educate the users on the potential dangers posed by these chemicals and methods of their application.

29. The indiscriminate disposal of human excreta on the open field or the use of faulty latrines has caused the greater part of the African soil to be grossly contaminated with pathogenic organisms such as Ascaris and nookworm, which cause debilitating diseases. There is a modest attempt in some African countries to establish standard designs for low cost latrines, but there is a clear need for a concerted effort to prevent soil pollution from human wastes.

Land degradation

30. Growing pressure on land, increasing use of chemicals, desertification, and deforestation are reducing the productivity of soils in many parts of Africa today. Removal of forest cover due to extensive agricultural practices, incautious use of chemicals and fertilizers, and soil erosion are destroying the soils and agricultural potential of scarce land resources and causing severe environmental damage.

31. Deforestation is caused mainly by forest removals for fuelwood, shifting cultivation and conversion to pasture land for cattle ranching and timber harvesting for construction. In Africa, shifting cultivation by subsistence farmers and removals for fuelwood are major causes. It is estimated in an FAO/UNEP report on a world-wide basis that fuelwood and charcoal removals from tropical forests are as much as eight times greater than for industrial wood. Nevertheless, there are acute local and even national shortages of fuelwood in Africa leading to cutting the last wood on slopes prone to erosion to secure warmth and cooling for the present. Generally, the causes of deforestation are summarised below:

(a) Increasing human pressure on forested areas from agriculture including shifting cultivation, extensive estate farming and extensive livestock raising, overstocking and overgrazing;

(b) Extensive utilization of wood in tobacco and other agro-based and allied industries;

(c) Extensive charcoal production for main urban areas particularly major cities. Unsollective cutting and felling of trees by traditional charcoal producers and insufficient management and regeneration measures leading to accelerated deforestation;

(d) Cutting of trees and collection of firewood by rural populations and vendors for sale in urban areas. This process generally begin around the urban centres and spreads radially farther away from the urban boundaries;

(e) Settlements, roads, and other infrastructural development including urbanization; and

(f) Destruction of forest cover and other vegetation by natural causes e.g. bushfires, overgrazing, drought, etc.

32. Tropical forests are the world's richest biological zones, and are estimated to contain as much as 40 per cent of all terrestrial species on the planet. Tropical forests provide a wide range of useful products (e.g. fuelwood, building materials, pulpwood, food, pharmaceuticals, resins, gums, dyes, etc.) of economic significance for both developing and developed countries. Serious degradation or loss of watershed forests in particular, has a wide range of major ecological and economic effects through increased erosion, floods, landslides, with the silting of hydro-electric facilities, irrigation systems, reservoirs and harbours.

33. Desertification is now perceived as intensifying world-wide, affecting over 100 countries in the world in varying degrees. Nearly nineteen countries in Africa are either partially or wholly desertified. The Sudano-Sahelian belt consist of countries in this situation. Although desertification is exacerbated by severe drought, its principal cause is human overexploitation of drylands through over-cultivation, overgrazing, poor irrigation and cultivation practices and de-forestation.

34. The most devastating environmental and economic effects of desertification are in developing countries in the drylands of Africa, Asia and Latin America. Poverty in the rural communities of Africa lead to over-exploitation of lands and forests for food, fuel, cash crops and meat for export. This leads to severe deforestation and removal of vegetation cover both of which play an important role in the hydrological cycle. Climatic changes occur over a long period which result in severe drought, and prolonged drought leads to the disappearance of vegetation cover, excessive wind erosion and desertification.

Other adverse effects on the African environment

35. Further to the environmental problems outlined above some serious environmentally related problems which Africa is facing today are:

- mineral exploration
- dumping of chemical and industrial waste
- bushfires
- squatter settlements and sanitation
- poverty

Mineral exploitation

36. Africa is endowed with rich natural resources including minerals. Its wealth of iron ore, gold, and other metals attracted many explorers and led to its colonisation by European powers. The minerals that were exploited were intended to feed the industries in Europe with very little wealth invested back into Africa except that intended to produce more minerals to keep the European industries in operation.

37. For example, the following mining activities are taking place in some of the sites shown in Figure 1 but very little action is taken to prevent air and water pollution, land pollution and ecological degradation. No country is known to have rehabilitated the excavated lands. Fig. 1 can be seen as Annex 4.

(a) North West Africa

This consists of the Atlas Mountains and adjacent lowlands (Morocco, Northern Algeria, Tunisia) and the Sahara Desert (Southern Algeria, Libya, Mauritania, Mali, Burkina Faso, Niger and Chad). Exploitation of natural resources such as oil, natural gas, iron ore, phosphates, lead, zinc, manganese and copper, mainly for export has brought considerable wealth to this subregion.

(i) Haemetite iron ore is quarried in the Kedia d'Idjil Range (Mauritania);

(ii) Underground mining of rich phosphate rock and open cast quarrying of phosphate-bearing sands take place at Khouribga (Morocco);

(iii) Lower grade phosphates are mined near Safi (Morocco) and at Gafsa (Tunisia);

(iv) Smaller quantities of other minerals are mined in the Tell and Atlas Mountains and include lead, zinc, manganese, and copper;

(v) In Mauritania salt is collected from evaporated sea water in coastal lagoons, and rock salt is mined near Taoudenni (Mali);

(vi) Oil is exploited from the sedimentary basins of Dagra (Libya) and Hassi Messaoud (Algeria).

(vii) Natural gas is exploited from Hassi R'mel (Algeria);

(viii) Small quantities of low grade coal are mined in close seams of anthracites at Djerada (Morocco);

(b) West Africa

The West African subregion consists of Sierra Leone, Ghana, Nigeria, Gambia, Senegal, Guinea, Ivory Coast, Benin, Togo, Guinea Bissau, and Liberia.

(i) Large open-cast methods are used to recover from river gravel industrial diamonds in Birim Valley (Ghana) and gem stones in the Sewa Valley (Sierra Leone);

(ii) High grade iron ore is quarried along benches on Mount Nimba (Liberia, Guinea), or Katoum Peninsula (Guinea) close to Conakry, in the Bomi Hills (Liberia), and lower grade iron ore from Bong Hills (Liberia) and Marampa (Sierra Leone);

(iii) Bauxite is easily excavated near Boké (Guinea) and also at Fria (Guinea); and Yenahin (Ghana);

(iv) Shallow gold mines exist at Tarkwa (Ghana);

(v) Manganese is quarried from ridges at Grand Lahou (Ivory Coast);

(vi) Tin bearing alluvial deposits are near Jos (Nigeria); and

(vii) Phosphates are worked by open cast methods at Taiba (Senegal).

(c) The Central Africa

This subregion consists of Congo, Zaire, Gabon, Equatorial Guinea, Cameroon, Central African Republic, Zambia, and Angola.

(i) Extensive deposits of high grade copper ore which are easily excavated by predominantly open-cast methods, occur at Nchanga (Zambia) and at Kolwezi (Zaire) with Cobalt. Smaller deposits are exploited in other mines opened in the copper belt;

(ii) Tin is quarried from alluvial deposits at Maniema (Zaire);

(iii) Large quantities of industrial diamonds are excavated from Backwanga river gravel (Zaire);

(iv) High grade manganese ore is quarried at Kisanda (Zaire) and at Maonda (Gabon);

(v) Large haematite iron ore reserves at Mekambo (Gabon) are quarried;

(vi) Thick seams of low grade coal are mined near Luanda (Angola) and Kinshasa (Zaire); and

(vii) Oil wells are sunk at Luanda (Angola) and natural gas at Port Gentil (Gabon).

(d) Southern Africa

This subregion consists of Zimbabwe, Botswana, Namibia, Swaziland, Lesotho and the white ruled South Africa.

(i) Gem diamonds are recovered from gravel on marine terraces along the Namibi coast (Niamibia);

(ii) Open-cast mines produce high grade asbestos at Zvishabani (Zimbabwe);

(iii) High grade coking coal is easily worked at Hwange (Zimbabwe); and

(iv) Iron ore, gold, coal, manganese ore, uranium are exploited in a non-ECA member State in the subregion.

38. As more and more sophisticated exploration equipment are developed, more mineral resources will be discovered and mines established. And if no pollution and ecological degradation measures are taken to abate increasing environmental degradation, Africa will face more serious environmental problems within the next decade or two.

Dumping of chemical and industrial wastes

39. Technological advancement and discovery of new chemicals to fight pests create a waste disposal problem of the highest magnitude. Africa like many developing countinents faces a modern and worst form of pollution, namely the

dumping of chemical wastes by arrangement with chemical companies from developed countries. An alarming discovery was observed where a US chemical company offered an African state an "annual fee" of up to $25 million to be allowed to dump its toxic chemical waste in that country. It is clear that Third World countries are being used as dumping grounds for products that have not been adequately tested or have been found to be sub-standard.

40. The real danger to Africa is that there is nothing Africa can collectively do about it now. Some Third World governments, plagued by balance of payments problems and foreign exchange shortages may be tempted by the big money involved to risk the environment, health, and may be even the lives of their citizens.

41. It is also common knowledge that some pharmaceutical industries from the developed countries release drugs to be marketed before their toxicity has been thoroughly investigated. The thalidomide case is one example that comes to mined quickly. It is most likely that several drugs on the market are undergoing human efficacy testing without regard to the harmful effects these may have to peoples of the developing countries. The trend in Africa is that Africans will continue to be used as guinea-pigs until legislative instruments are promulgated to put this malpractice to a stop.

Bush fires

42. It is the practice in many African countries when opening up new farmland or pasturelands to either burn the forest first to clear the undergrowth and facilitate the felling of trees or fell the trees, put them into heaps and burn them. This form of bushfire is as devastating as that set on a plantation -- both destroy in a few hours what nature has built in half a century. In a well established woodland, there is very little grass but plenty of green creeping undergrowth which would not support a fire for long. Where trees have been cut there is much more grass and the fire is much hotter and spreads quickly.

43. The density of woodland in Africa has been reduced severely and tropical moist forests have disappeared and replaced by degraded grassland. The following are some of the observed consequences caused by bushfires:

(a) When trees and grass burn, ashes (which contain mineral salts) are produced which may be washed away or percolate into the soil when it rains. With time the salts form an impermeable layer just below the surface preventing water from percolating deeper into the soil. This causes the soil to become very dry soon after the rains have stopped and renders the soil unable to support any vegetation. Tree seedlings will be unable to penetrate the hard pan of salts and will also die. The area then becomes dry, bare and treeless:

(b) If the grass in such areas is burned during the dry season, it may sprout for a short while using its moisture reserves but once this source is exhausted, the grass dries up and die; and

(c) If this happens in catchment areas and slopes of mountains, heavy soil erosion, floods, and siltation of water reservoirs occur. In a recent study, a Danish scientist in Tanzania postulated that this process leads to desertification and my be the process which led to desertification in the Middle East and North Africa.

Squatter settlements and sanitation

44. Over the past two decades, Africa has experienced a high rate of rural urban migration. Most of these migrants end up living in slums and squatter settlements. It is estimated that today there are 84 cities in industrialized countries and 74 cities in developing countries with a million or more inhabitants. By the year 2000 there will be 276 such cities in developing countries alone, the World Housing Survey 1974 estimated. Between one and two-thirds of the present population in cities in developing countries now live in slums and squatter settlements.

45. Slums and squatter settlements are rapidly becoming, and in many cities already are, a serious urban housing problem in developing countries. The population of developing countries grows by approximately 2% annually, their cities by 4% and their slums and squatter settlements by 8% annually. In most cases, the cities' actual growth equals the growth of squatter settlements since there is little real upgrading and very little new low-income housing.

46. With only about a quarter of Africa's population living in urban areas, the continent is now experiencing the highest urban growth rate in the world; nearly 5% per annum. It is expected that urban areas in Africa will continue to grow at well over 4% until the end of the country. Slums and squatter settlements account for 90% of the population of Addis Ababa, 51% of Accra, 33% of Nairobi, 45% of Lusaka and 50% of Monrovia.

47. The attitude that slums and squatter settlements have no legitimate place in the city and are to be eliminated, still lingers in the planning and policy attitudes of many governmental agencies throughout the world. Acts of slum clearance which leave the poor in a worse position than they were before are far from rare, but, the sheer volume of slum and squatter population has made this attitude more and more impractical.

48. Recent governmental approaches to slums and squatter settlements can be grouped into three categories: laissez-faire, restrictive or preventive, and supportive. No noticeable signs of the various supportive policies have been adopted in many countries. The following are some of the supportive policies or actions that may alleviate the slum and squatter settlement problems:

(a) Security of tenure (ownership or leasehold) would provide an important impetus for improvement of housing and the community environment; and

(b) Provision of public utilities to existing slums and squatter settlements would go a long way in improving the living environment of the squatters. Such facilities should include water, sewage, electricity, roads, medical facilities, schools, and so on.

(c) The relevant sections of building codes and regulations should be reformulated to levels that would be affordable by squatters as a step towards maintaining a safe environmental sanitation in settlements.

Poverty and underdevelopment

49. Poverty is by far the most important cause of environmental destruction. It degrades the human environment and also obstructs development. For instance, the lack of safe drinking water for over 1300 million people, and sanitation for over 1700 million people in developing countries is caused by poverty, due to lack of financial and material resources for improving the conditions of the people in the process of development. Hence, poverty and underdevelopment result in the worst form of environmental degradation in the developing countries. According to a recent WHO survey, the lack of safe drinking water and sanitation is responsible for 50,000 deaths a day and for 80 per cent of the world diseases.

50. Poverty has contributed, too, to human population pressure. A recent survey by UNICEF has shown that high mortality rates act as an encouragement for larger families. The poor in the rural areas, slums, and squatter settlements see in a largest possible family a chance of security in old age. If the rate of population increase is to be slowed significantly, the poor must be given reason to have confidence in their future by ensuring that they have a major stake in the development process and an equitable share in the benefits of development.

51. Absolute poverty and malnutrition increase among people living at or near the subsistence level. According to FAO, nearly 50 per cent of the rural population of the developing countries now live below the official poverty line. No development which does not tackle the main causative agent or environmental impoverishment is worthy of the name.

Monitoring and protection of the African environment

52. The process of monitoring pollution is the first and most significant step in the protection of the African environment. For this process to be established African states need to enact legislations for atmospheric pollution prevention, water pollution prevention and ecological degradation prevention. These legislations should

establish enforcement machinery with provisions for the development of regulations to be followed by both the polluting or ecological degradation agent and the prevention authority.

53. There is a wide range of instruments available on the market for monitoring air pollutants, and utilizing a variety of sampling and analytical techniques. These instruments are grouped into two general categories:

(a) Equipment which only collect air samples with analysis being performed away from site; and

(b) more expensive direct-reading instruments which collect and analyse the air samples on site.

Most importantly, the type of instruments, sampling and analytical techniques used, will depend upon the source and type of air pollutant being monitored. Table I shows the sources and types of air pollutants prevalent in Africa.

Air pollution monitoring

54. There are three general applications in monitoring air contaminants:

- emission source monitoring
- occupational exposure monitoring, and
- ambient air quality monitoring

In all three cases the design of a monitoring programme for quantitatively appraising air quality is a difficult task. Steps to be taken in designing an air quality monitoring programme is given in Figure II. The objectives of air pollution monitoring are given below:

(a) Source monitoring

55. Most industrial processes based on chemical reactions have at their end point a stack through which waste products are ejected into the atmosphere. Two main reasons in monitoring air quality at this point are:

(i) the efficiency of the overall process/operation or of any pollution abatement equipment may be assessed, and

(ii) by measuring how much pollution is being discharged to the atmosphere, it is possible to determine whether the emission level complies with emission standards or regulations.

Table I: Sources and types of air pollutants

Type	Aerosols	Gases	Vapours
Combustion process	dust, fume	NO_2, SO_2 CO_2	Organics, acids
Automotive engines	fume, smoke	NO_2, CO, SO_2	Organics, acids,
Chemical processes	dust, mist fume, spray	(process-dependent) CO_2, SO_2 NH_3, H_2S	Odours, acids, solvents, organics
Flouro-and Electro-metallurgical process	dust, fume	SO_2, CO, Fluorides	Organics
Petroleum operations	dust, mist	SO_2, H_2S, NH_3, CO	hydrocarbons mercaptans
Mineral processing	dust, fume	(process-dependent) SO_2, CO_2, AsH_3, Fluorides	organics
Food and Feed Operations	dust	-	Odours
Biological decay (sewage, refuse)	fume mist	CH_4, H_2S NH_3	Odours
Wind Storms	dust	-	-

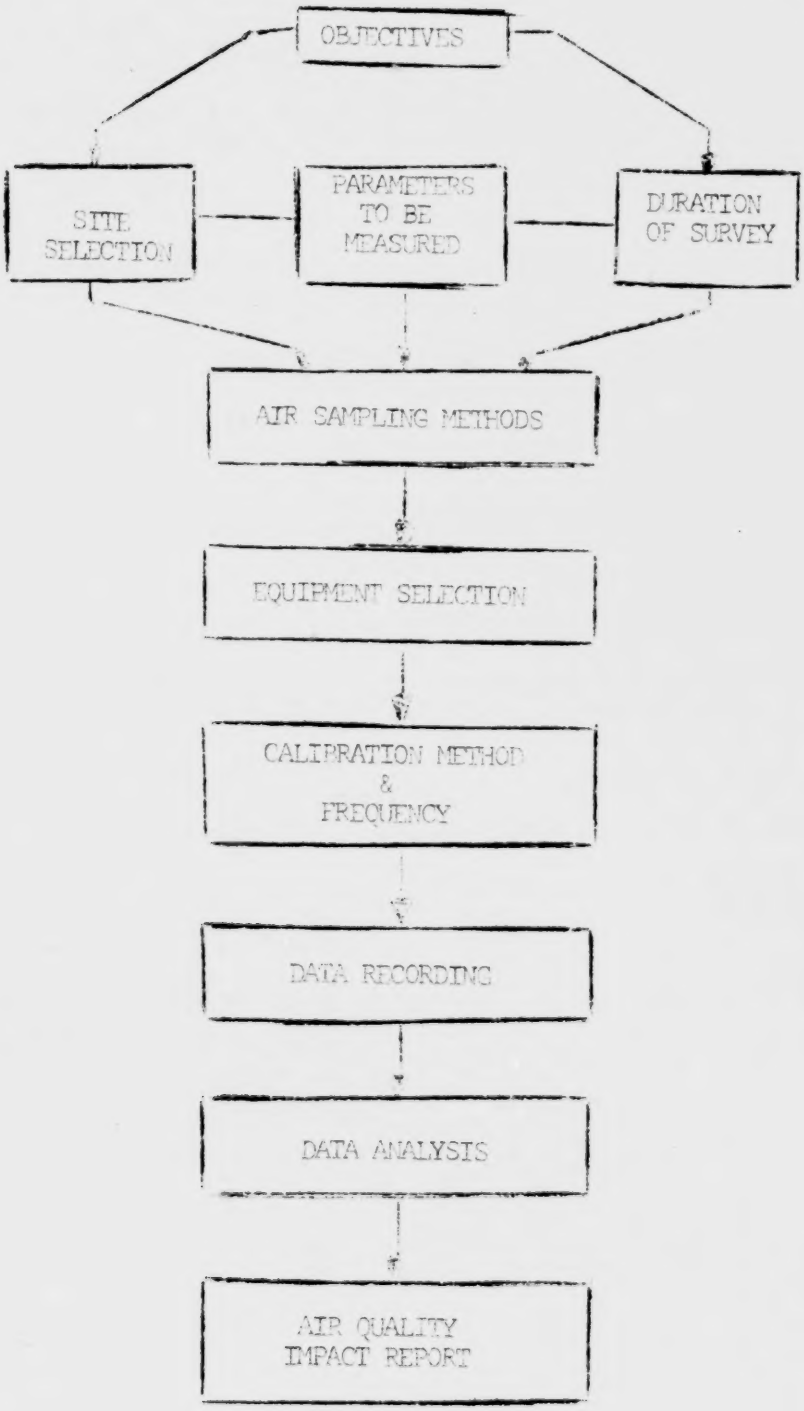

Fig. II: Steps in the design of an air quality monitoring programme

56. There are basically three types of air quality monitoring:

- short period (grab) sampling
- intermittent sampling
- continuous sampling

(i) Grab samples - have limited value and usually used for random checks or where pollution concentration are known to be constant;

(ii) Intermittent sampling refers to sampling on a regular but discontinuous basis e.g. every few minutes or few hours, and therefore allows many of the fluctuations in air pollution concentration to be identified.

(iii) Continuous sampling, however, enables diurnal, seasonal, and annual fluctuations to be measured and therefore allows a more accurate analysis of air quality.

57. A variety of other factors need to be considered when selecting a measurement method or specific instrument. The final choice will probably be a compromise between conflicting demands on accuracy required, calibration, averaging time, response time, specificity of the method, sensitivity and range of instrument, data output, practicability of method or instrument, and costs involved.

58. Stack gases are usually sampled by one of the following methods:

(i) absorption of the gas sample by an absorbing liquid;

(ii) absorption onto activated carbon, alumina or silica gel;

(iii) freeze-out trap, whereby the gas is drawn through a trap immersed in a low temperature bath (such as dry ice and acetone) and the condensed contaminants collected; and

(iv) grab sampling of gas from the stack by evacuated metal or glass container.

The gases commonly sampled include carbon dioxide, carbon monoxide, sulphur oxides, nitrogen oxides, organic vapours and halogen compounds.

59. The methods most commonly used for particulate contaminants sampling are:

(i) filtration - fibre filters, granular filters;

(ii) Impingement - wet or dry impingers; cascade impactors;

(iii) sedimentation - sedimentation in stagnant air; thermal precipitators

(iv) centrifugal force - cyclones

(v) precipitation - electrostatic precipitators; thermal precipitators.

(b) Occupational monitoring

60. The most common purpose for sampling air at the workplace is to evaluate accurately the exposure of workers to one or more contaminants for determining compliance with regulations or commonly accepted standards. The latter are generally taken to be the average concentrations in air below which the contaminants are normally harmless on occupational exposure and have been variously designed as the Threshold Limit Values (TLVs), the Maximum Allowable Concentrations (MACs), the Toxic or Permissible Limit, etc.

61. Another basic purpose of workplace air sampling is to indicate whether there is any risk of explosion from particulates or gaseous fumes. For gases or vapours that form flammable mixtures with air or oxygen, there are maximum and minimum concentrations above and below which the rapid propagations of flame (explosion) does not occur on contact with a source of ignition. The upper and lower explosive units (UEL and LEL respectively) are usually expressed in terms of percentage by volume. As the LEL of a substance is often many hundred times higher than its TLV, flammable gas detectors need not be as sensitive as toxic gas detectors, but such equipment must be intrinsically safe. Further, workplace monitoring includes evaluation of the effectiveness of engineering control measures, process changes or personal protective devices.

62. When testing workplace atmospheres for conformity with occupational health standards, the aim is to take samples, over an appropriate time interval, either in the breathing zone of the worker using personal samples and/or at a height of 1.5 m (nominal head height) if static location is chosen. For gases and vapours, air samples can be collected on the site and then analysed in the laboratory using chromatography, infra-red, ultra-violet, or colorimetric methods. There are three main methods of collecting air samples:

(i) Liquid bubbles - air is drawn through a suitable liquid at a known rate and the liquid then analysed for pollutants (e.g. benzene is selenous acid; sulphur dioxide in hydrogen peroxide);

(ii) Charcoal adsorbers - used mainly for organic gases and vapours, air is adsorbed onto the surface of charcoal, followed by regeneration or desorption and analysis by gas chromatography;

(iii) Gas bags - air is collected in an evacuated bag normally of 5 to 25 litre capacity. The lining of the bag must be inert and non-porous to the sampled gas.

(c) Ambient air monitoring

63. Wherever there is an intentional (or possible accidental) release of air borne contaminants into the community environment, a sampling programme is required to provide data for assessing the potential health or nuisance effects and to determine compliance with air quality standards or objective. However, the biological data concerning the effects of individual pollutants (let alone mixtures of pollutants) on humans, animals, vegetation, aquatic ecosystem, etc. are often inadequate. This makes it impossible to fix accurately a practical maximum concentration below which one can be sure no significant effects will occur. For this reason, and because the population at risk is exposed continuously and includes more susceptible individuals (e.g. the old, the infirm and the very young), ambient air quality standards are usually many times lower than occupational standards.

64. Another common purpose for an ambient air pollution monitoring programme is to establish baseline levels of air pollutants prior to construction or development activities. Such a study, whether conducted by an industrialist or a pollution control agency, can help promote good public relations, while the results can be used to evaluate the adequacy of pollution control measures, as well as providing a base upon which the impact of the development on air quality and the validity of any allegations of malpractice or claims for damage can be adequately assessed.

65. Because the nature of the air pollution problem varies from area to area, depending on the peculiarities of meteorology, topography, source characteristics and legal and administrative constraints, ambient air monitoring programmes will vary accordingly in scope, content and duration. In general, however, pollutants to be monitored are selected on the basis of their:

(i) representing a definite hazard;

(ii) possibility of becoming hazardous to health or welfare in the near future; and

(iii) being controlled by existing or proposed standards.

66. The choice of the number and location of monitoring sites should consider:

(i) source-oriented monitoring;

(ii) zone(s) of highest actual or projected pollutant concentrations;

(iii) background studies for industrial development;

(iv) areas of high population density; and

(v) other sensitive or critical areas.

Detailed site location also depends on such factors as accessibility, availability of space, need for electric power, water and security, etc. The duration of monitoring is usually governed by the use to be made of the data, financial resources and statistical validation.

67. Ambient air samples can be collected for subsequent laboratory analysis using techniques described above (paragraph 62). However, as with occupational monitoring, the trend is towards the use of continuous direct reading instruments using a variety of techniques. Continuous analysers are available for the measurement of ambient concentration of a range of gases including carbon dioxide, ozone, hydrogen sulphide, nitric oxide, nitrogen dioxide, sulphur dioxide, total hydrocarbones, methane, oxidants, and hydrogen fluoride. Table II summarises some of the more common measurement methods used in monitoring ambient air quality. However, increasingly popular is the technique for montiroing ambient air quality utilizing biological indicators such as lichens and mosses which derive their nutrients from atmospheric moisture and dust.

Water pollution monitoring

68. The continuously rising demand, in Africa today, for water for domestic and industrial purposes and the increased use of rivers, estuaries and coastal water for fisheries, recreation, waste disposal, irrigation, power generation and navigation have resulted in an urgent need for careful management of aquatic systems. Monitoring programmes can help achieve this by providing information on water flows and water quality. However, the monitoring programmes, whether designed for effluents or receiving waters, must be related to some desired end or objective, otherwise redundant data will be collected with a concomitant waste of resources and time.

Table II: Commonly measured pollutants and methods used

Pollutant	Method*
Grit and dust fall	- Bucket, jar, British Standard deposit gauge (monthly)
Suspended particulates - total - smoke	- USA high volume filter (gravimetric; 8 hourly) - British Standard smoke filter (soil index; daily) Tape - filter (soiling index; hourly)
Sulphur dioxide	- West-Gaek (specific for SO_2; daily) - H_2O_2 followed by analysis for sulphate (specific for SO_2; daily) - H_2O_2 followed by titration or determination of conductivity (not gaseous acidity; daily or continuous) - coulometric (specific for SO_2; continuous) - Stratmann silica gel (8-hourly)
Sulphuric acid mist	- double filtration (daily)
Carbon monoxide	- non-dispersive infra-red (continuous)
Ozone	- Chemiluminescence
Oxidants	- neutral KI (daily)
Methane	- flame ionization (continuous)
Higher Hydrocarbons	- flame ionization (continuous)
Nitric oxide	- chemiluminescence - reaction with O_3 (continuous)
Nitrogen dioxide	- Saltzman (daily or continuous) - chemiluminescence - reduction to NO, then reaction with O_3 (continuous)

* Continuous methods are those operating automatically

69. The basic objective of an effluent monitoring programme is to provide a characterisation and understanding of the waterborne waste materials being produced by the industrial processes. Although regulatory agencies normally only require monitoring of the waste streams which leave the factory sites, it is now recognized that a comprehensive monitoring programme can locate inefficient and wasteful operations and lead to reduced manufacturing costs. In addition to any legal requirements and the necessity of preventing violations, a monitoring system can provide protection for inaccurate accusations of illegal or harmful waste discharge practices. Adequate monitoring records can document that a facility was operating in conformity with permit requirements.

70. An effluent/waste monitoring system should be an integral part of every manufacturing process and be used as a measure of efficient operation. Once incorporated into the production system, it will be an invaluable check on the overall efficiency of plant operation as well as an aid in meeting legal requirements. The monitoring programme will also provide basic data that will be valuable in the design of a wastewater treatment system to meet regulatory requirements. One of the first tasks in establishing a monitoring programme should be an examination of the water usage and waste generation characteristics of the manufacturing process itself.

71. In most cases, the main purposes for monitoring receiving water quality are to obtain baseline pollution data and to assess the suitability of the water, in chemical and biological terms, for the uses to which it is put or is likely to be put in the future. Hydrological stations established at strategic points on main rivers and streams throughtout a country would provide such baseline data.

72. A wide range of equipment is used for water sampling, the selection of which depends upon the type of sample required. There are three types of sampling procedures used, namely, grab sampling, composite sampling, and continuous sampling.

(a) Grab sampling - involves collection of water samples in a random fashion. Such samples are generally collected manually and only reflect the conditions and characteristics existing at the time of collection;

(b) Composite sampling - involves collection of samples at regular intervals of time and combining them to produce a composite sample. Composite samples tend to level off peaks and represent average conditions over the sampling period. Composite samples may be on the basis of time interval or flow rate;

(c) Continuous sampling - involves abstracting continuously portions of water from the source either at fixed or variable flow rates. This process requires the use of automatic continuous water quality monitors which do not require very heavy use of trained manpower but they are expensive.

73. The quality of natural or treated water, raw sewage, sewage treatment plant, effluent or industrial effluent can be characterised by the results from the various physical, chemical, and biological tests conducted on them. Table III lists some common tests which, although they may not represent the most modern and sophisticated methods, are capable nevertheless of producing accurate results provided they are performed by a competent analyst with a reasonably equipped laboratory.

74. Chemical analysis of water is not wholly satisfactory in determining baseline conditions of the aquatic environment. Unless chemical analysis can be undertaken either on a continuous or a frequent and regular basis (usually prohibited by costs), an incomplete picture of ambient conditions is obtained. Biological monitoring enables the path of a pollutant to be traced both up the food chain and back to its original source often when chemical traces have long disappeared.

Ecological degradation monitoring

75. From earlier discussions, air and water pollutants invariably cause terrestrial pollution and ecological degradation. Land may become polluted not only through the addition of specific contaminants but also through alteration to such a degree and/or in such a manner as to render it unsuitable for its present or planned use. For example, deforestation, soil erosion, removal of vegetation and soil cover through bushfires, overgrazing and overstocking, are forms of land pollution. The land may also become a hazard or nuisance to the adjacent population under conditions of uncontrolled use.

76. Action which may result in terrestrial pollution include:

(a) the disposal of domestic solid waste by landfill operations. Domestic refuse consists of dust and ash, paper and cardboard, metals, rags, glass, plastics, and vegetable and putrescible matter;

(b) the disposal on land of industrial solid and liquid, and hazardous/toxic wastes such as metal-bearing sludges, strongly acidic/alkaline wastes, organic residuals and sludges, waste oils, etc;

(c) mining and smelting operations including such operations as land stripping, quarrying, formation of slag heaps, disposal of stripped soil and rock;

(d) the demolition of existing land-based structures yielding residual debris and rubble, e.g. wood, bricks, stones, concrete and other discarded building materials;

Table III: Some important water quality tests, their chief significance and general means of measurement

Quality parameter	Significance	General method of analysis: expression of result
Colour (apparent)	Suspended and dissolved solids	Colorimetric method: comparison with platinum - cobalt standard: unit of colour being produced by 1 mg/l platinum in the form of chloroplatinate ion.
Odour	Most organic and some inorganic chemicals	Subjective Perceived Odour: Threshold Number
Turbidity	Estimate of suspended matter	Jackson candle turbidimeter (Jackson units) or Nephelometric method (Formazin Units)
Dissolved oxygen	Potential for oxidation of organic matter; life support	Titration or electrode: per cent saturation or mg/l
Carbon dioxide	Aerobic/anaerobic decomposition of organic matter; carbonate equilibrium	Nomographic, titration; mg/ of CO_2
Suspended solids	Turbidity; treatment efficiency	Gravimetric: mg/l
Settleable solids	Turbidity: treatment	Imnoff Cone: ml/l
Dissolved solids	Salinity: may affect ecosystems and domestic and agricultural usefulness	Gravimetric: mg/l
Total solids	General polluting potential	Gravimetric: mg/l
Calcium	Hardness: scale formation	Titration and gravimetric: mg/l of $CaCO_3$

Quality parameter	Significance	General method of analysis: expression of result
Magnesium	Hardness; taste; possible gastrointestinal irritation; scale formation	Colorimetric; atomic absorption spectroscopy: mg/l of Mg
Hardness	Soap consumption; scale formation	Titration: mg/l of $CaCO_3$
Oil and grease	Toxic potential; physical damage	Chemical and comparametric: mg/l
Acidity/alkalinity	Amount of acid/alkali present; corrosion etc.	Titration: mg/l of $CaCO_3$
pH value	Intensity of acid or alkali present; strength of effluents affects many chemical and biological properties	Titration; electrode; colorimetric: pH values 0-14
Chloride ion	Degree of pollution with sewage; degree of salt water intrusion; taste, corrosion in hot water systems	Titration or colorimetric: mg/l of Cl
Stability/saturation with respect to calcium carbonate	Ability to maintain oxidized condition; tendency to revert to anaerobic conditions with foul odours	Stability/saturation index
Biochemical oxygen demand (BOD)	Extent of biodegradable organic matter	Measurement of dissolved oxygen before and after incubation for 5 days at 20°C: mg of oxygen consumed per litre
Chemical oxygen demand (COD)	Organic matter susceptible to oxidation by a strong chemical oxidant	Titration: mg/l of oxygen consumed from standard dichromate solution
Permanganate values	Oxidizable inorganic matter, also very easily oxidized organic matter	Titration: mg/l of oxygen consumed from a standard permanganate solution
Permanganate values (4-hour)	Oxidizable inorganic and organic matter	

Quality parameter	Significance	General method of analysis: expression of result
Total organic carbon (TOC)	Extent of organic matter	Titration: mg/l of organic carbon
Organic nitrogen	Extent of nitrogenous organic matter	Colorimetric or titration: mg/l of organic nitrogen
Ammonia nitrogen	Extent of decomposition nitrogenous organic matter (protein); toxicity	Titration: mg/l of ammonia nitrogen
Nitrate nitrogen	Extent of oxidation of NH_3; plant nutrient; may serve as source of O_2; toxic in excessive amounts (methaemoglobinemia)	Colorimetric or titration: mg/l of nitrate nitrogen
Nitrite nitrogen	In conjunction with ammonia and nitrate, nirites are often indicative of pollution	Colorimetric: mg/l of nitrite nitrogen
Phosphate	plant nutrient	Colorimetric: mg/l of phosphate as P
Sulphate	Possible reduction to H_2S; corrosion of concrete; possible gastrointestinal irritation	Gravimetric or photometric: mg/l of sulphate as SO_4^{2-}
Cyanides	Toxic potential	colorimetric or titration: mg/l of cyanide
Phenols	Toxic potential; odour; taste	Titration; chromatography; colorimetric: mg/l of phenol
Synthetic detergents	Foam; toxic potential; taste	Colorimetric; titration: mg/l of specific detergent
Pesticides	Toxic potential	Gas chromatographic method: mg/l of pesticide
Iron	Taste; discolouration; turbidity; growth of 'iron' bacteria	Colorimetric; atomic absorption spectroscopy: mg/l of Fe

Quality parameter	Significance	General method of analysis: expression of result
Manganese	Taste; discolouration; turbidity	colorimetric; atomic absorption spectroscopy: mg/l of Mn
Zinc	Taste; turbidity	Colorimetric; atomic absorption spectroscopy: mg/l of Zn
Copper	Taste; discolouration; corrosion	Colorimetric; atomic absorption spectroscopy: mg/l of Cu
Cadmium	Toxic potential	Colorimetric; atomic absorption spectroscopy: mg/l of Cd^2
Silver	Toxic potential	Colorimetric, atomic absorption spectroscopy: mg/l of Ag
Chromium	Toxic potential	Colorimetric; atomic absorption spectroscopy: mg/l of Cr
Fluoride	Potential for fluorosis at certain concentrations	Colorimetric; electrode: mg/l of F
Lead	Toxic potential	Colorimetric; atomic absorption spectroscopy: mg/l of Pb
Selenium	Toxic potential	Colorimetric: mg/l of Se

(e) the burning of solid wastes on land sites leaving tyre residuals, cans, ash;

(f) the storage (either temporarily or permanently) of building materials, oil drums, discarded automobiles, rubble and rock, etc.; and

(g) the damming or draining of land to impound or remove excess water.

77. When performed in an uncontrolled or inappropriate manner, the above activities can have a number of undesirable effects on the environment. Generally, these effects can be categorised as follows:

(a) aesthetic/nuisance effects - producing a general unsightlyness by, for example:

(i) changing land form, stripping of vegetation;

(ii) storage of undesirable materials, burning and demolition, etc;

(iii) production of unpleasant odours, such as those generated by decomposing organic matter; and

(iv) attraction of pests.

(b) ecosystem effects - damage to flora and fauna caused by:

(i) the direct action of toxic waste;

(ii) drainage of swamp or marsh areas;

(iii) increased run-off, erosion, flooding and siltation following land clearance or damming; and

(iv) contamination of surface waters by leachates and run-off from waste tips

(c) human health and safety

(i) fires or explosions from improper storage of materials;

(ii) breeding of disease carriers (e.g. rats, flies, mosquitoes) at sites of decomposing organic matter;

(iii) contamination of food (e.g. vegetables, fish) or drinking water by direct dumping or by leachates/run-off from waste tips.

78. The treatment and disposal of ever-increasing volumes and types of industrial and domestic wastes represents one of the major problems faced by Governments and municipal and health authorities throughout the world. Areas for concern include:

(a) the high costs involved, inefficient, improper or hazardous operations;

(b) public opposition to disposal practices; and

(c) a shortage of suitable disposal sites.

There are five major methods of disposing of waste to land:

(a) deep well injection, in which liquid waste is deposited in subsurface strata; very little is known about the chemical reactivity and fate of compounds after subsurface injection;

(b) slurry deposition in surface lagoons;

(c) spoil heaps in which waste (normally from mineral working) is deposited on the land surface;

(d) controlled tipping (sanitary landfill), where waste is deposited in depressions, derelict mineral workings, etc. and covered to produce a new land form;

(e) uncontrolled tipping, where waste is deposited in a totally random fashion and without regard to local environmental considerations.

79. Pretreatment and recycling of waste has been found to be most useful in reducing waste destined for land disposal. The following pretreatment methods are currently employed:

(a) pulverising or shredding - refuse is less offensive visually and less attractive to vermin; volume is not initially greatly reduced but waste is more easily compacted at the tip.

(b) composting - offers a means of assisting the natural recycling of the combustible content;

(c) incineration - reduces volume to less than 10% of original and produces a sterile ash; and

(d) high density baling - waste is less offensive visually and more easily controlled. Studies have shown that leachate produced from baled waste contains lower concentrations of BOD, total dissolved solids, nitrate and sulphide over a period of two years following waste emplacement.

80. Alternative methods and techniques to reduce or eliminate the need for land disposal include the following:

(a) separate collection;

(b) resource recovery for useful materials and for refuse-derived fuel

(c) pyrolysis

(d) composting after preliminary sorting; and

(e) other chemical or biological processes such as hydrolysis, fermentation for ethanol production, methanation.

These methods offer opportunities in the reduction of waste destined for disposal on land and for production of new forms of energy from organic matter.

Environmental protection legislation

81. It is important to examine the ways various countries protect their environments. As the means and equipment used depend, in the main, on the type of pollution, it is appropriate to examine these means in terms of air pollution, water pollution, land degradation (desertification, drought and human settlement), mining. Legislation has been observed as the only means used in the protection of the environment.

82. From the foregoing, experience in Africa and other parts of the world over the past half century, has shown that private companies and man left alone could continue to damage the environment if no legislative instruments are set to regulate their activities. The legislative instruments existing in various African countries show varying degrees of emphasis on some types of pollution such as air pollution, water pollution, and ecological degradation. Below is a summary of the legislations that exist in some countries in Africa on:

(a) waste and misuse of water

(b) health preservation

(c) pollution

(d) environmental protection and other control measures

(a) Waste and misuse of water

(i) Kenya and Sierra Leone have penalties for offenders;

(ii) Burundi, Swaziland and Zambia have general prohibition against wastage and penalties for offenders.

(b) Health preservation

(i) Benin and Burkina Faso have well and washing place inspection regulations; waste disposal and cesspool standards;

(ii) Burundi has several provisions to protect the public;

(iii) Gabon health authorities have a special legislation.

(c) Pollution

(i) Burundi - general prohibition against water pollution and pollutant effluents may be discharged under permit.

(ii) Ethiopia - Water Rules and Codes - the Addis Ababa Water and Sewerage Authority has certain powers;

(iii) Mauritius - Central Water Authority is responsible for preventing pollution (Rivers and Canals Ordinance also deals with this;

(iv) Kenya - extensive anti-pollution legislation (Water Affairs Boar');

(v) Water pollution is an offence in Swaziland. Water Sewerage Board has considerable authority to act in matters of pollution prevention;

(vi) Zambia and Sierra Leone have extensive anti-pollution legislation which imposes responsibility for prevention either on private individuals or government.

(d) Environmental protection and other control measures

(i) Ethiopia's constitution charges its government to conserve the country's natural resources, including water;

(ii) Burundi has a National Commission to study environment protection;

(iii) Sierra Leone Water Authorities are under obligation to indicate the probable effects of their proposed development schemes.

83. Zimbabwe and Egypt are but examples of countries which have legislations on air pollution. The main handicap observed is lack of enforcement machinery including manpower. Egypt has well equipped laboratories at the National Research Centre on air and water pollution with adequately trained manpower. Where legislations exist on sanitation, health and water resources development, and the different aspects of these are enforced by separate institutions, there does not seem to be adequate collaboration and cooperation among the separate institutions.

84. Legislations must be dynamic and applicable even to the rapidly changing technological advancement. They should be reviewed and revised at least every five years to ensure that they continue to serve the purpose intended. If the present situation is left to continue, environmental difficulties are bound to erupt which may be too costly to solve.

85. African countries should ensure that the enforcement bodies established to implement legislations on pollution are given optimum support so that proper facilities are set up for the monitoring of environmental protection efforts or degradation. The major problem for the future is to allow industrial development to occur outside the framework of the environment protection system. Before any project is implemented, it is necessary to assess the impact of all the components of the proposed project on the physical, biological and social environment, through environmental impact assessment(EIA) studies.

Standards for air quality, water quality and ecological degradation

86. A standard is a technical document available to the public, drawn up with the cooperation and consensus or general approval of all interests affected by it based on the consolidated results of science, technology and experience, aimed at the promotion of optimum community benefits and approved by a body recognized on the national, regional or international level. A standard may take the form of:

(a) a document containing a set of conditions to be fulfilled;

(b) method of sampling or inspection;

(c) method of test or analysis;

(d) code of practice including, instruction and operation manuals, byelaws, etc;

(e) forms and contract forms.

87. Experience has shown that most standards or product specifications can be implemented by industries voluntarily because the benefits are immediate and tangible. The standards relating to health, occupational safety, environmental protection, energy conservations, consumer protection are viewed by industry as a cost and are of interest to government alone. Nothing short of mandatory enforcement of such standards would encourage industry to comply with the standards. Standards for air quality, water quality and ecological degradation fall in the category of standards that could be enforced mandatorily if industry and large scale estate farmers are to comply.

Standards for air quality

88. There are a number of ways of utilizing standards to maintain or achieve a pre-determined level of air quality and thereby limit the exposure of populations, ecosystems, etc. to air pollutants. The two most common types of standards are ambient air quality and emission standards:

(a) Ambient air quality standards

Ambient air quality standards are limits placed on levels of air pollutants in the ambient air during a given period of time, designed to achieve air quality objectives or an acceptable level of air quality. Although what is considered to be acceptable may vary from country to country, there are upper and lower guideline concentrations. For example, air can never have a concentration of any substance lower than the global background concentration of that substance, so standards must be greater than these levels (see Table IV). On the other hand, standards should be set at levels below those known to represent a substantial danger to human health, aquatic life or vegetation. The WHO issued guidance on harmful levels for some pollutants and proposed the concentration shown in Table V as long-term goals intended to prevent undesirable effects from sulphur oxides and suspended particulates, carbon monoxide and photochemical oxidants. Table VI gives a compilation of guidelines on ambient air quality standards derived from a recent study of world wide air quality management standards by Martin and Stein. It was found from the study that the USSR was the first country to set air quality standards in 1951 and by 1973 had standards for 114 substances. These air quality standards represent the minimum pollutant concentrations tolerable by man or test animals and are used by several eastern European countries.

(b) Emission standards

(i) Emission standards for stationary sources are limits specifying maximum allowable levels of pollutants in discharge from a site, process, chimney, vent, etc. with the intention of helping to achieve a desired quality. As with ambient air quality standards, emission standards are often a reflection of not only technological (i.e. process and equipment) considerations but also economic, sociological and political considerations. Emission standards may be either officially promulgated or presumptive.

Table IV: Sources and background concentrations of selected pollutants

Pollutant	Natural source	Background concentration (ug/m^3)
Sulphur dioxide	volcanoes	1 - 1
Hydrogen sulphide	volcanoes; biological decay	0.3
Nitric oxide	Bacterial action in soil, photodissociation of N_2O and NO_2	0.3 - 2.5
Nitrogen dioxide	Bacterial action in soil oxidation of NO	0.2- 2.5
Ammonia	Biological decay	4
Carbon monoxide	Oxidation of methane; photodissociation of CO_2; forest fires; oceans	100
Ozone	Tropospheric reactions and transport from stratosphere	20 - 60
Hydrocarbons	Biological processes in swamps	CH_4 = 1000 non-CH_4 1
Reactive	Biological processes in forests	1

Table V: Guideline tolerances recommended for long-term goals[1]

Pollutant	Measurement Method	Tolerance level ($\mu g/m^3$)	
Sulphur oxides[2]	British Standard procedure[3]	Annual mean 98% of observation[4] below	200
Suspended particulates[2]	British Standard	Annual mean 98% of observation[4] below	40 120
Carbon monoxide	Nondispersive infra-red[3]	8-Hour average 1-Hour maximum	10 40
Photochemical-oxidant	measured by neutral buffered KI method expressed as ozone	8-Hour average 1-Hour maximum	60 120

1/ These are recommendations given by the WHO (1972).

2/ Values for sulphur oxides and suspended particulates apply only in conjunction with one another.

3/ Methods are not necessarily recommended but indicate those on which these units have been based.

4/ The permissible 2% of observations over this limit may not fall on consecutive days.

Table VI: Guideline tolerance limits for ambient air pollutants

	Long Term Limits		Short-Term Limits	
	mg/m^3	$\bar{+}$ (hours)	mg/m^3	$\bar{+}$ (min.)
Acetic acid	0.06	24	0.2	30
Acetone	0.35	24	0.35	30
Ammonia	0.20	24	0.2	30
Aniline	0.03	24	0.05	30
Benzene	0.3	24	1.5	30
Benzine	0.05	24	0.05	20
Cadmium	0.003	24	0.01	30
Chromium	0.001	24	0.0015	30
Dichloromethane	1.0	24	3.0	30
Diethylamine	0.05	24	0.08	30
Diethyl ether	65.00	½	155.0	30
Dimethylamine	0.005	24	0.005	30
Dimethyl Disulphide	0.2	24	0.7	30
Carbon monoxide	1.0	24	5.0	30
Carbon tetrachloride	2.0	24	4.0	30
Chlorine	0.03	24	0.1	30
Chloroform	10.0	½	50.0	30
Dimethyl sulphide	0.05	24	0.08	30
Ethanol	5.0	24	5.0	30
Ethylene	5.0	24	5.0	30
Ethlyene oxide	0.05	24	0.3	30
Fluorides (as F)	0.005	24	0.02	30
Fluorides	0.01	24	0.03	30
Formaldehyde	0.012	24	0.055	30
Furfural	0.05	24	0.08	30
Hexachlorohexane	0.01	24	0.08	30
Hydrochloric acid	0.006	24	0.006	30
Hydrocarbons (total)	2.0	24	5.0	30
Hydrogen canide	0.01	24	-	-
Hydrogen sulphide	0.003	24	0.003	30
Lead	0.001	24	0.002	30
Lead sulphide	0.001	24	-	-

Table VI (continued)

Substance	Long-Term Limits		Short-term Limits	
	mg/m^3	± (hours)	mg/m^3	± (min.)
Malathion			0.015 ppm	30
Intrathion	0.001	24	0.001	30
Manganese	0.01	24	0.03	30
Mercury	0.0003	24	-	-
Methanol	0.5	24	1.0	30
Methyl acetate	0.07	24	0.07	30
Methyl acrylate	0.01	24	0.08	30
Methyl methacrylate	0.1	24	0.1	30
Methylparathion	-	-	0.008	30
Methylene Chloride	20.0	½	55.0	30
Mono Methylamine	0.01	24	0.01	30
Naphthalene	0.008	24	0.008	30
Nitric acid	0.006	24	0.006	30
Nitrobenzene	0.008	24	0.008	30
Nitrogen dioxide	0.085	24	0.085	30
Nitrogen monoxide	0.4	½	0.8	30
Nitrogen oxides	0.004	24	0.1	30
Oxidants	0.08	24	0.1	60
Ozone	0.1	24	0.2	30
Pentane	25.0	24	100.0	30
Phenol	0.1	24	0.8	30
Phosphoric acid	0.1	24	0.3	30
Phosphorus Pentoxide	0.05	24	0.15	30
Propanol	0.8	24	1.00	30
Propylene	5.0	24	5.0	30
Pyridine	0.08	24	0.08	30
Silica	0.02	24	0.1	120
Soot	0.05	24	0.15	30
Styrene	0.08	24	0.008	30
Sulphur dioxide	0.05	24	0.5	30
Sulphuric acid	0.1	24	0.5	30
Suspended particulates	0.15	24	0.5	30
Tetrahydrofuran	0.2	24	0.2	30
Tetrachloromethane	-	-	4.0	30
Thiophene	-	-	0.6	30
Toluene	0.6	24	0.6	30
Toluene dissocyanate	0.02	24	0.05	30
Trichloroethylene	1.0	24	0.14	30
Triethylamine	0.14	24	0.14	30
Turpentine	25.0	1/2	75	30
Vanadium pentoxide	0.002	24	-	-
Vinyl acetate	0.15	24	0.15	30
Xylene	0.2	24	0.2	30

Table VII: Guideline emission limits for particulates in effluent air from stationary sources

Source	Limits (mg/m^3)
Combustion of fuels	
Bark burning (pulp mills)	250
Blast furnace gas burning	50
Central stations	200 - 500
Coal burning	100 - 500
Oil burning	50 - 250
Heavy oil burning	50 - 300
Solid fuel burning	100 - 500
Incineration of refuse	150 - 1000
Asphalt plants	70 - 5000
Carbon black manufacture	40 - 60
Cement production	150 - 500
Coal processing	150
Coke manufacture (metallurgical)	40 - 60
Electrode manufacture	150
Furnances	75 - 600
Kilns (cement)	75 - 600
Kilns(ceramics)	150 - 600
Kilns (lime)	300 - 600

Table VIII: Guideline emission limits for specific pollutants in effluent air from stationary sources

Substance	Limits (mg/m^3)
Acid gases	200 - 3000
Aldehydes	20
Ammonia	3 kg/hour
Antimony	20 - 100
Arsenic	20 - 100
Benzene	24.0 kg/hour
Beryllium	0.1
Cadmium	1.0 - 40
Carbon	50 - 250
Carbon dioxide	10% by volume
Carbon disulphide	100 - 500
Chlorine	3.0 - 200
Copper	20
Formaldehyde	0.5 kg/hour
Fluorine	1.0 - 100
Fluorine compounds	20 - 50
Heavy metals (total)	10.0
Hydrochloric acid	100
Hydrofluoric acid	100
Hydrogen fluoride	1.0 - 230
Hydrogen sulphide	5 - 1500
Lead	10 - 100
Manganese	0.1 kg/hour
Mercury	3.0 - 20
Nickel	20
Nickel·carbonyl	0.5
Nitric acid	500 - 4000
Nitrogen oxides	350 - 100
Organic compounds	50
Sulphur dioxide	30 - 3000
Sulphuric acid	5.0 - 1000
Sulphur trioxide	100 - 200
Sulphur trioxide and sulphuric acid mist	0.8 kg/ton acid
Vinyl chloride	10 - 2000 ppm

(ii) In a study from information from 37 countries by Martin and Stein, (1974) (EPA-650/9-75-0012), it was found that 17 countries in Europe, America and Asia had emission standards covering 32 substances. As can be seen in Tables VII and VIII, the guideline emission limits for particulates and non-particulates are related to a unit of feed or product of a given industry or based upon the volume of gas generated. It should be borne in mind that the advantages of emission standards are that they relate to the point of discharge of the pollution. Once the standards have been set and test methods defined, it is relatively simple to sample, analyse and determine compliance of individual emitters. However, the application of uniform standards to an emitter in a rural location and one in the centre of an industrial city may not be cost-effective. The rural plant will invest heavily in abatement equipment with a small reduction in damage to receivers and hence a small benefit to the enforcer of the standards. For this reason selective application of standards may be a useful approach which will take into account the costs and the location of the plant.

(c) Other air pollution standards

89. There are other types of air pollution standards worthy of consideration:

(i) Point of impingements standards

When exhausts leave a chimney they disperse in the form of a diverging plume. These standards set limits on the concentration of pollutants where the plume intersects the ground and are normally used in diffusion computation to determine limits of emission. These are very hard to enforce especially where there are chimneys close to each other;

(ii) Chimney height standards

This is a very effective way of keeping ambient air quality within specified limits unless there are too many chimneys in one area or the chimneys are of inadequate height;

(iii) Emergency procedure standards

These standards relate to emergency procedures which would allow action to be taken well before levels of pollutants have threshold concentrations;

(iv) Fuel standards

Here the amount of sulphur dioxide discharged from fuel burning installations is limited by the sulphur content of the fuel burned or the amount of lead emitted from motor-cars is limited by the lead content of the petrol. The use of fuel standards can be a very effective means of controlling emission, although they are not cost-effective when ambient levels are already well within acceptable limits;

(v) Buffer zone standards

A buffer zone or protection zone is a required separation distance between a source of environmental nuisance or hazard and areas inhabited or frequented by the general public. Normally other factors, in addition to air pollution such as noise, vibration, radioactivity and fire or explosion hazard are used in determining the width of the buffer zone;

(vi) Visible emission standards

Visible emission standards are intended to control the emission of black, dense or dark smoke from chimney or vehicle exhausts;

(vii) Odour emission standards

There are few standards of this type because of the problems inherent with the subjective evaluation of odour nuisance and intensity;

(viii) Fluoride in herbage standards

This is another approach of managing air quality which involves the setting of limits on the concentration of a pollutant in a target or receptor;

(ix) Deposited particulate matter standards

Deposited grit and soot are among the most objectionable forms of air pollution and a number of countries have set standards for particulate matters deposited by sedimentation, washout or dust fall onto or into exposed receptacles;

(x) Workroom air standards

The Treshold limit values (TLVs) the maximum Allowable Concentration (MACs) or Toxic or Permissible limits being the concentration in air below which a contaminant is normally harmless on occupational exposure are set to protect the workforce.

Standards for water quality

90. There are two main types of water quality management standards, namely

- water quality standards (stream standards)

- emission standards (effluent standards)

Water quality standards

As different uses normally require water of different qualities, it has been necessary to investigate and define standards of quality for each significant use. Standards or requirements for the protection of the following water uses should be established, i.e. for drinking water supply, aquatic life, agricultural supply, recreation and industrial supply.

(a) Drinking water standards

The WHO has established the International Standards for Drinking Water and the European Standards for Drinking Water which lay down the minimum hygienic quality recommended for all countries and all European countries respectively as shown in Tables IX and X;

(b) Standards for protection of Aquatic life

Another common water quality standard is that aimed at the protection of aquatic ecosystems as a whole or sensitive individual species within the ecosystem. Water pollutants can reduce the dissolved oxygen content, change the temperature, or affect the behaviour, reproduction and physiology of the organisms or can kill the organism outright. The parameters that must be controlled are, temperature, dissolved oxygen, pH, suspended solids, the Biochemical Oxygen Demand (BOD), toxic chemicals, pesticides and hydrocarbons;

(c) Standards for agricultural uses of water

These standards are important because of differences in crop sensitivity to salinity and toxic substances. Also, it is necessary to protect animal health and the safety and value of agricultural products from contamination with polluted water. Table XI gives the recommended quality of irrigation waters and livestock drinking water supply.

Table IX: WHO limits for toxic substances in piped water supplies compared with the corresponding USSR, USA and proposed EEC values (mg/l)

Substance	WHO limits		USSR values	USA values	EEC (maximum admissible concentrations)
	European	International			
Lead (as Pb)	0.1	0.1	0.1	0.05	0.05
Arsenic (as As)	0.05	0.05	0.05	0.05	0.05
Selenium (as Se)	0.01	0.01	0.001	0.01	0.01
Chromium (Cr^6)	0.05	-	0.1	0.05	0.05
Chromium (Cr^3)	-	-	0.5	-	-
Cadmium	0.01	0.01	0.01	0.01	0.005
Cyanide (as CN)	0.05	0.05	0.1	0.2	0.05
Mercury (as Hg)	-	0.001	0.005	0.002	0.001
Berium	1.0	-	4.0	1.0	0.1

Where water undertakings still use lead piping, concentrations may be higher but in no instances higher than 0.3 mg/l after 15 h contact with the pipes.

Table X: WHO limits for substances affecting the acceptability of water for domestic purposes compared with the corresponding, USSR, USA and proposed EEC values (mg/l)

Substance	WHO LIMITS			USSR limits	USA limits	Proposed EEC limits	
	European	International					
		Highest desirable	Maximum permissible			Guide level	Maximum admissible Concentration
Phenolic compounds (as phenol)	0.001	0.001	0.002	0.001	-	-	0.0005
Fluoride (as F)	1.0-1.7[a]	-	0.8-1.7[a]	0.7-1.5[b]	1.4-2.4[a]	-	0.7-1.5[a]
Nitrate (as NO_3)	50-100	-	-	10 (as N)	10 (as N)	-	0.7-1.5[a]
pH	-	7.0-8.5	6.5-9.2	6.5-8.2	-	6.5-8.5	9.5
Copper (as Cu)	0.5[c]	0.05	1.5	1.0	-	-	0.05[c]
Iron (as Fe)	0.1[c]	0.1	1.0	0.3	-	0.1	0.3
Manganese as(Mn)	0.05	0.05	0.5	0.1	-	0.02	0.05
Zinc (as Zn)	5.0	5.0	15.0	5.0	-	-	0.1[c]
Magnesium (as Mg)	30-125[d]	30-150[d]	150	-	-	30	50
Sulphate (as SO_4)	250	200	400	500	-	5	250
Hydrogen sulphide (as H_2S)	0.05	-	-	Sulphides:	-	-	nil
Chloride (as Cl)	200-600	200	600	350	-	5	200
Chlorine, free	-	-	-	nil	-	-	-
Anionic detergents	0.2	0.2	1.0	individual limits	-	-	0.1
Ammonia (as NH_4)	0.05	-	-	2.0 (as N)	-	0.05	0.5
Carbon dioxide free	nil	-	-	-	-	-	-
Calcium (as Ca)	-	75	200	-	-	100	-
Mineral oil	-	0.01	0.3	0.5	-	-	0.01
Mineral oil with high S content	-	-	0.1	0.1	-	-	-
Turbidity (units)	-	5	25	1.5	1[c]	5	10
Organic	0.2-0.5	-	-	-	0.7	0.1	-

(a) Depending on temperature
(b) Varies according to climatic conditions
(c) Under certain circumstances higher levels
(d) Depending on sulphate concentration
(e) Carbon chloroford extract

Table XI a: Recommended maximum concentrations of trace elements in irrigation waters* (mg/l)

Element	For waters used continuously on all soil	For use up to 20 years on fine textured soils of pH 6.0 to 8.5
Aluminium	5.0	20.0
Arsenic	0.10	2.00
Beryllium	0.10	0.50
Boron	0.75	2.0-10.0
Cadmium	0.010	0.050
Chromium	0.10	1.0
Cobalt	0.050	5.0
Copper	0.20	5.0
Fluoride	1.0	15.0
Iron	5.0	20.0
Lead	5.0	10.0
Lithium	2.5+	2.5+
Manganese	0.20	10.0
Molybdenum	0.010	0.050‡
Nickel	0.20	2.0
Selenium	0.020	0.020
Vanadium	0.10	1.0
Zinc	2.0	10.0

* These levels will normally not adversely affect plants or soils, no data available for mercury, silver, tin, titanium, tungsten.

+ Recommended maximum concentration for irrigating citrus is 0.075 mg/litre.

‡ For only acid fine-textured soils or acid soils with relatively high iron oxide contents.

Table XI b: Recommended maximum concentrations of toxic substances in livestock drinking water supplies (mg/l)

Parameter	U.S.A.	Australia
Aluminium	5.0	-
Arsenic	0.2	1.0
Boron	5.0	-
Cadmium	0.05	0.01
Calcium	-	1.000
Chromium	1.0	1 to 5
Cobalt	1.0	-
Copper	0.5	0.5 to 2.0
Fluoride	2.0	2.0
Iron	-	10.0
Lead	0.1	0.5
Magnesium	-	250 to 500
Mercury	0.01	0.002
Molybdenum	-	0.01
Nitrate (as NO_3)	-	90 to 200
Nitrite (as N)	10	-
Nitrate + Nitrite (as N)	100	-
Selenium	0.05	0.02
Sulphate	-	1.000
Vanadium	0.1	-
Zinc	25	20

(d) Standards for protection of recreational uses of water

Standards are necessary to preserve the aesthetic appeal of recreational waters used for swimming, boating, fishing etc.

(e) Industrial water supply requirements

Water quality requirements differ for various industrial processes even within a single plant. Modern water treatment technology is capable of treating almost any raw water to render it suitable for any industrial use. By way of example, summary tables are given for the following industries:

(i) Textile Industry (Table XII);

(ii) Pulp, Paper and Allied Industries (Table XIII);

(iii) Chemical and Allied Industries (Table XIV); and

(iv) Miscellaneous Industries (Table XV).

(f) Effluent standards

Water quality management systems based on the use of effluent standards require that monitoring is carried out by sampling the effluent at the point of discharge. Table XVI indicates guideline effluent standards. However, there are three main different approaches to the setting of effluent standards:

(i) Best available technology approach

This approach requires that the removal of pollutant should be as complete as current technology allows. The system affords maximum available protection to the environment and means that improvements in water quality should closely follow technical innovations in effluent treatment. It does not take into account the degree of toxicity, the fates of substances and the assimilative capacity of rivers, lakes, dams etc;

(ii) Uniform emission standards approach

This system requires the establishment of uniform standards irrespective of the location of the discharge. Such standards are usually based on the pollution potential of effluent and/or the effectiveness of current treatment technology. They are easy to administer but can result in overprotection in some areas and underprotection in others depending on the assimilative capacity of the receiving water bodies;

Table XII: Quality requirements of water at point of use for the textile industry

Characteristics	Cotton, Wool, Synthetics (mg/l)				Viscose Rayon (mg/l)	
	Sizing suspension	Scouring	Bleaching	Dyeing	Pulp manufacture	Manufacture
Iron (fe)	0.3	0.1	0.1	0.1	0.05 (Fe + Mn)	0.0
Manganese (Mn)	0.05	0.01	0.01	0.01	0.03	0.0
Copper (Cu)	0.05	0.01	0.01	0.01	5	
Filterable residue	100	100	100	100	100	
Suspended solids	5	5	5	5		
Hardness ($CaCO_3$)	25	25	25	25	8	55
pH, units:						
Cotton	6.5-10	9.0-10.5	2.5-10.5	7.5-10.0		
Synthetics	6.5-10	3.0-10.5	not applicable	6.5-7.5		7.8-8.3
Wool	6.5-10	3.0-5.0	2.5-5.0	3.5-6.0		
Colour, units	5	5	5	5		
Turbidity, units				15	5	0.3
Aluminium (Al)					8	
Silica (SiO_2)					25	
Alkalinity ($CaCO_3$)					50-75	

Table XIII: Quality requirements of water at point of use for the Pulp, Paper and Allied Industries

(Unless otherwise indicated, values are in mg/l and should normally not be exceeded).

Reference	Groundwood or Mechanical pulp	Ground-wood paper	Bleached Kraft	Bleached Chem. pulp & paper	Unbleached Kraft	Unbleached Chem. pulp & paper	Fine paper
pH, units	6-10			6-10		6-10	
Colour, units	30	30*	25	10	100	30	5
Turbidity, units		50	40		100		10
Calcium (Ca)	X			20		20	20
Magnesium (mg)	X			12		12	12
Iron (Fe)	0.3	0.3	0.2	0.1	1.0	1.0	0.1
Manganese (Mn)	0.1	0.1	0.1	0.05	0.5	0.5	0.05
Aluminium (Al)	X			X		X	
Zinc (Zn)	X			X		X	
Sulphate (SO_4)	X			X		X	
Chloride (Cl)	1000	25-75	200	200	200	200	
Silica (SiO_2)	X	50	50	50	100	50	20
Hardness ($CaCO_3$)	X	200	100	100	200	100	100
Alkalinity ($CaCO_3$)		150	75		150		40-75
Filterable residue	X	500	300	X	500	X	200
Suspended solids	X			10*		10*	
Temperature °C	X			35		X	
Free Carbon dioxide		10	10		10		10
Corrosion tendency		NO	NO	NO	NO	NO	NO
Residual chlorine		NO	NO		NO		2.0

* No gritty or colour-producing solids present.

X Accepted as received; has never been a problem at concentration encountered.

Table XIV: Quality requirements of water at point of use for chemical and allied industries (mg/l)

Reference	Alkalies and Chlorine	Organic Chemicals	Inorganic Chemicals	Clear Plastics	Synthetic Rubber	Drugs & Pharmaceuticals	Soap & Detergents	Paints	fertilisers
pH, units	X	6.5-8.7	X	X	6.2-8.3	X	X	X	X
Colour, units	X	X	X	2	20	X	X	X	X
Turbidity, units				2					
Taste & Odour (threshold no.)	X	X	X	X	X	X	X	X	X
Calcium (Ca)	2	68	X	X	80	X	X	X	X
Magnesium (Mg)	2	19	X	X	35	X	X	X	X
Iron (Fe)	0.1	0.1	X	0.02*	0.1	X	X	X	X
Manganese (Mn)	0.1	0.1	X	0.02*	0.1	X	X	X	X
Bicarbonate (HCO_3)	X	128	X	X		X	X	X	X
Sulphate (SO_4)	X	X	X	X	X	X	X	X	X
Chloride (Cl)	X	X	X	X	X	X	X	X	X
Nitrate(NO_3)	X	X	X	X	X	X	X	X	X
Silica(SiO_2)	X	X	X	X	X	X	X	X	X
Hardness($CaCO_3$)	low	250	X	X	350	X	X	X	X
Alkalinity($CaCO_3$)	X	150	X	X	150	X	X	X	X
Filterable Residue	X	X	X	200	X	X	X	X	X
Suspended Solids	X	X	X	X	X	X	X	X	X
Dissolved Oxygen(O_2)	X	X	X	X	X	X	X	X	X
Chemical Oxygen Demand (O_2)	X	X	X	X	X	X	X	X	X
Biochemical Oxygen Demand (O_2)	X	X	X	X	X	X	X	X	X

* Fe and Mn total

X Accepted as received; has never been a problem at concentration encountered

+ Australian practice generally requires low colour (5 Hazen units), low turbidity (1 unit) and low filterable residue (10 mg/l).

Table XV: Quality requirements of water at point of use for miscellaneous industries

Reference	Concrete	Cement (Hydraulica)	Electroplating: Metal finishing	Electroplating: Rinse	Laundering	Photographic processes	Petroleum Refining
pH, units		6.5-8.5			6.0-6.8	7.0-8.5	6.0-9.0
Colour, units		X				none	X
Turbidity, units						low	
Calcium (Ca)		X					75
Magnesium (Mg)	low	X					30
Iron (Fe)		25		low	0.2(1.0)*	0.1	1
Manganese (Mn)		0.5			0.2(1.0)*	0.1	
Copper (Cu)						0.1	
Bicarbonate(HCO_3)					low	150	
Carbonate (CO_3)				low			X
Sulphate (SO_4)	low	250		low		200	X
Chloride (Cl)		250				**	300
Nitrate(NO_3)				low			X
Silica(SiO_2)		35				20	X
Hardness ($CaCO_3$)		X		low	0.50	40-150	350(7) (a)
Alkalinity ($CaCO_3$)		400			60		
Acidity ($CaCO_3$)		0					
Filterable Residue		600	low			250	1,000
Suspended Solids	(C)	500				low	10
Hydrogen Sulphide (H_2S)						0.1	
Chemical Oxygen Demand		X					
Carbon Tetrachloride Extract		1					
Free Carbon Dioxide	20		15				
Corrosion Tendency	NO						

* Fe and Mn total.
** For black and white reversal 25 mg/l, for colour processing 100 mg/l.
(C) Free from acids, alkalies, oil and decayed vegetable matter; SO_3 should be less than 25 mg/l.
X Accepted as received, has never been a problem at concentration encountered.

Table XVI: Effluent standards in Singapore

	Limit for Discharge into a Public Sewer (mg/l)	Limit for Discharge into a Watercourse other than a Controlled Watercourse (mg/l)	Limit for Discharge into a Controlled Watercourse (mg/l)
pH	6-9	6-9	6-9
Temperature	45°C	45°C	45°C
Total Suspended Solids	400	50	30
Total Dissolved Solids	3,000	2,000	1,000
Chloride (as chlorideion)	1,000	600	400
Sulphate (as SO_4)	1,000	500	200
Sulphide (as sulphur)	1	0.2	0.2
Cyanide (as CN)	2	0.1	0.1
Chlorine (free)	-	1	1
Phosphates (as PO_4)	-	5	2
Nitrate(as NO_3)	-	-	20
Calcium and Magnesium	-	200	150
Detergents (b)	30	15	5
Grease and Oil	60	10	5
Arsenic	5	1	0.05
Barium	10	5	5
Tin	10	10	5
Iron (as Fe)	50	20	1
Beryllium	5	0.5	0.5
Boron	5	5	0.5
Manganese	10	5	0.5
Phenolic Compounds (expressed as phenol)	0.5	0.2	Nil
BOD (5-day)	400	50	20
COD	600	100	60
Metals:			
Cadmium	1	0.1	0.01
Chromium (trivalent and (hexavalent)	5	1	0.05
Copper	5	0.1	0.1
Lead	5	0.1	0.1
Mercury	0.5	0.05	0.001
Nickel	10	1	0.1
Selemium	10	0.5	0.01
Silver	5	0.1	0.1
Zinc	10	1	0.5
Total metals	10	1	0.5

Notes:

(a) Water course from which water supplied by the Public Utilities Board under the Public Utilities Act is obtained.

(b) Linear alkylate sulphonate as methylene blue active substances.

(iii) Local effluent standards

In this approach, discharge standards are set with reference to local conditions to achieve a predetermined quality objective. Such standards are therefore set with the needs of the whole river system in mind and as they take into account the differences in flow and water use requirements, they may vary widely from one part of a river to another. Such standards are bound to be viewed more favourably by industry as effluents are not required to be treated to a level higher than that shown not to result in environmental damage.

Activities on ecological preservation

91. In many African countries today legislations have been enacted in the fields of agriculture, forestry, water resources development and sanitation with the prime objectives of:

(a) developing water resources without depleting the natural underground waters and degrading the supply of surface water;

(b) upgrading the health of the urban and rural communities by providing regulations which control urban and rural sanitation activities;

(c) improving the production of agricultural sector and providing for the eradication of pests and diseases;

(d) controlling the production, manufacture and sale of meat products;

(e) protecting the wildlife, catchment areas, natural rain forest and rivers;

(f) controlling the use of land for agriculture, wildlife, urban and rural settlements, mining, etc.; and

(g) controlling industrial waste water effluents, solid waste disposal, air effluent emissions, land degradation from mining, road construction, etc.

92. In addition to the general provisions of the legislations enacted each sector such as the crop, land and animal husbandry, mining industry, etc. is controlled by regulations developed under the purview of the legislations. Through these regulations deforestation, overgrazing, bushfires and improper agricultural practices are brought under control. As it takes a long time for people to change their long established habits, some countries in Africa have strong agricultural extension services whose purpose is to teach and educate the people by demonstration and using visual-aids and audio-visual systems. Firstly, the people are shown how harmful to the environment, uneconomic and wasteful, and beneficial it would be if they adopt the new and better practices which are being promoted.

Institutional arrangements (National and regional levels)

93. As discussed above, Africa faces serious danger of environmental degradation demanding immediate and urgent institutional arrangement at both national and regional levels during the Industrial Development Decade for Africa 1980 - 1990. Activities aimed at monitoring environmental changes and degradation and protecting the environment are in operation in many African countries in varying degrees of success. Significant among these institutional arrangements at national and regional levels are those in the following areas:

- Environmental sanitation and health, and safe drinking water supply;
- Soil degradation and deforestation;
- Drought and desertification;
- Water pollution and conservation of marine resources;
- Human settlements;
- Mining;
- Air pollution and weather forecasting;
- Environmental education and training, legislation and information.

Environmental sanitation and health, and safe drinking water supply

94. At national level activities on environmental sanitation and health and safe drinking water supply are the responsibilities of government institutions such as:

(a) Water pollution control departments

Where these exist, the institutions are established as enforcements agencies. The function of such institutions is to co-ordinate overall water pollution control activities at national level. The agency establishes regulations that include water quality standards for surface waters, drinking water and for effluents and waste waters. These standards or regulations are used by industries, sewage treatment plants, mining industries and water supply authorities.

(b) Sewage treatment works

These institutions are normally departments of the city authorities or of a government ministry responsible for the treatment of sewage. Associated with these institutions in the city authorities are the health departments whose responsibilities are to maintain good sanitary and health within the city boundaries. The treatment of sewage may involve the following processes:

(i) Dilution (especially by those close to the coast;

(ii) Conventional treatment process which involves four main stages:

- Preliminary treatment
- Sedimentation (settlement tanks)
- Filtration using biological filters
- Sludge disposal (through anaerobic sludge decomposition)

(iii) Activated sludge process;

(iv) Oxidation ponds (or stabilization ponds)

The liquid sewage effluent can be discharged into rivers or used for irrigation purposes and the solid dried sludge can be used as manure for agricultural purposes or for land reclamation.

(c) Environmental health departments

These institutions are generally established under the Ministry of Health with the central responsibility for:

(i) food and beverage control;

(ii) industrial and occupational hygiene;

(iii) housing and solid waste management;and

(iv) general sanitation.

(d) Water supply authorities/boards

These institutions are generally established under separate legislation but some are part of city authorities. In either case, they treat raw water in accordance with laid down regulations, water quality standards or WHO recommended water quality standards.

(e) Government analyst's laboratories

This institution is mainly established under the Ministry of Health to conduct microbiological and chemical tests on water, clinical samples from the hospitals, etc. in accordance with acceptable international or national methods of test. Other government departments and ministries also avail the services of such laboratories as analysis work emanating from other government institutions is conducted.free of cost.

(f) National standards bodies

These institutions are established to develop and implement national standards. In the process, they set up laboratories equipped with the most up-to-date equipment to conduct a wide range of tests for compliance with standards. Some undertake contract analysis for government, industry and the general public.

Soil degradation and deforestation

95. Special agricultural research institutes are established to monitor soil degradation with the view of producing from time to time soil fertility and degradation condition of the country. Soil degradation and deforestation are sometimes areas attracting much academic research at universities and so a wealth of information is generated. Soil degradation and deforestation are of special interest to the ministry of agriculture and conservation, natural resources, irrigation or forestry in many countries in Africa.

Drought and desertification

96. The ministries of agriculture and conservation are generally interested in drought and desertification. The meteorological department collects agrometeorological data for use by the government in the determination of the climatic changes that may indicate incipient drought. The ministries of agriculture through the agricultural research institutes or forestry research institutes do initiate research to monitor the agricultural practices likely to exercabate drought and desertification and take necessary action timely.

Water pollution and conservation of marine resources

97. The monitoring of water pollution in many African countries is the responsibility of government institutions, such as:

(a) Water pollution control departments

These institutions may be just water departments or laboratories established by legislation to enforce water and effluent standards as indicated in paragraph 94(a) above.

(b) Fisheries departments

The departments of fisheries have vested interest in the maintenance of water quality in order to provide good habitat for the aquatic life. They sometimes conduct research on the effects of pollutants on the behaviour, reproduction and physiology of fish and other aquatic fauna. Such research assists in providing additional information on the toxicity of various pollutants.

(c) National standards bodies

The role of the NSBs in this respect is to develop standards and implement them and also provide any contract testing services that may be required or implement any standards that may be in force at any given moment.

Human settlements

98. The threatening and rapid expansion of cities in Africa and the increasing slum and squatter settlements call for immediate action in better planning of towns, villages and other human settlements and in the provision of adequate municipal

facilities such as water, housing facilities such as water, housing, electricity, sanitation, etc. The housing aspect in urban areas is the responsibility of city authorities and housing corporations. The current problem in many African cities today is the expanding slum and squatter settlements which are not provided with any municipal facilities because slums are considered illegal and should be pulled down. Some national standards bodies have been entrusted with the task of developing standards for building materials and national building codes so that they can play an important role in developing materials standards and building codes that can accommodate the purchasing power of the low income groups, especially those living in slums and squatter settlements.

Mining

99. Ecological degradation arising from mining activities are controlled by the relevant institutions responsible for water pollution, air pollution and land degradation. The ministry of mines also lay down some regulations regarding waste disposal, protection of polluted areas, etc.and so on.

Air pollution and weather forecasting

100. The control of air pollution starts at the planning stages when the zoning and siting of industrial areas, housing estates, etc. are made. Institutions which are mainly involved in the monitoring and control of air pollution are summarized below:

(a) Air pollution prevention department

There are very few African countries that have established Air Pollution Prevention legislations. Where they exist their responsibility is to co-ordinate all air pollution control activities at national level through a series of regulations in order to control industrial air pollution, domestic air pollution, motor vehicle exhaust emission, pollution, etc.

(b) Meteorological services authorities

These are institutions whose responsibilities are to obtain information on the direction and speed of wind and the stability or instability of the atmosphere. These authorities also monitor background air pollution through stations established in the countryside. Baseline air pollution stations are established in remote area with nearly 100 kilometres radius away from human settlements. Fully developed and supported, these authorities can also monitor actual air pollution arising from automobiles, industries, domestic activities, etc.

Environmental education, training, legislation and information

101. Environmental education, training and information are new approaches which have not found much ground in many African countries. Where these exist there is an Environmental Education Unit which produces pamphlets, brochures and other

informational materials for dissemination. The unit prepares visual aids and audio-visual materials for use in schools and colleges by a mobile unit. Such institutions are usually attached to the Ministries of agriculture. There are very few countries in Africa with comprehensive legislation to control and monitor environmental degradation. However, several countries have so far established national committees on environment entrusted with the responsibility for all environmental activities at national level.

Regional institutional arrangements

102. At regional level, there are basically few institutional arrangements available for environmental control and monitoring of which the following are most significant:

(a) The United Nations Economic Commission for Africa (ECA)

The ECA,through its interest in the economic development of Africa,has been actively involved in the environmental activities through its Environment Section in its Division of Social Development, Environment and Human Settlements. In the Plan of Action for the implementation of the Monrovia Strategy for the economic development of Africa recommended by the ECA Conference of Ministers responsible for economic development at its sixth meeting held in Addis Ababa, in 1980, the importance of promoting an environmentally sound socio-economic development of Africa was recognized. The ECA recognises that in order to promote the accelerated development of Africa within the framework of the New International Economic Order, environmental factors have to be taken into account to reduce social and economic costs that arise from neglect and utter disregard of problems of pollution, soil degradation, resources depletion, desertification, flooding, water-borne diseases, climatic changes and others that result from various development processes and patterns.

(b) The African Regional Organization for Standardization (ARSO)

ARSO is a regional intergovernmental body established in 1977 by the ECA and is committed to the development of regional standards in many fields including environmental protection which would stimulate the concerted efforts at national level to establish the same for proper environmental control and management in member States. ARSO has already established a technical committee - ARSO/TC.9 on Environmental Protection and Pollution Control whose scope is to undertake standardization activities in the field of environmental protection, sanitation and pollution control.

(c) United Nations Sudano-Sahelian Office (UNSO)

UNSO is the only institution in the United Nations system whose mandates are concerned exclusively with drought and desertification. Eleven years ago it started with 8 countries and now it has nineteen. UNSO assists eight states members of the Permanent Inter-State Committee on Drought Control in the Sahel (CILSS) in their drought-related programmes of recovery and development and all 19 countries of the Sudano Sahelian region in combating desertification.

(d) Other subregional groupings and UN agencies assisting in combating the deteriorating conditions of the environment are:

(i) Institutionalized cooperation in international river and lake basins (see Table XVII);

(ii) The WMO is deeply involved, in conjunction with the Meteorological Services in African countries, in the alleviation of drought and promoting the improvements in weather forecasts and the standardization and dissemination of weather observations taken over the entire globe in 157 members of the United Nations.

(iii) UNEP (United Nations Environment Programme)

The UNEP has organized several study and training projects in Africa separately or jointly with other agencies in the fields of:

- Human Settlements technology
- Human and environmental health
- Ecosystems (mountains, islands), wild life, endangered species, national parks, reserves, etc.
- Oceans (marine pollution, resources)
- Environment and development
- Natural disasters
- Energy
- Earthwatch
- Environmental management
- Supporting activities (training, education, technical assistance, information)

(iv) The FAO has launched several programmes and field projects concerned with agricultural and forestry development problems of arid and semi-arid lands. Many of the activities of the FAO related to the implementation of the UN Plan of Action to Combat Desertification fell within three major divisions:

- Land and water development
- Range management and
- Forestry

Table XVII: Institutionalized cooperation in international river and lake basins

Region and basin	Name of institution - member countries - headquarters	Year of agreement
(1)	(2)	(3)
Africa		
Chad	Chad Basin Commission/Commission du Bassin du Tchad - Cameroon, Chad, Nigeria, Niger, Ndjamena (Chad)	1964
Gambia	Gambia River Basin Co-ordinating Committee - Gambia, Senegal	1976
Kagera	Inter-state Organization for the Development of Kagera River Basin - Burundi, Rwanda, United Republic of Tanzania	1971
Mano	Mano River Union - Liberia, Sierra Leone, Guinea	1976
Niger	River Niger Commission/Commission du Fleuve Niger - Benin, United Rep. of Cameroon, Chad, Guinea, Ivory Coast, Mali, Niger, Nigeria, Upper Volta - Niamey(Niger)	1963 1964
Niger (Upper)	Technical Committee for Flood Forecasting and Warning System, Guinea, Mali	1969
Nile (Lower)	Permanent Joint Technical Commission for Nile Waters - Egypt, Sudan - Khartoum (Sudan)	1959
Nile (Upper)	Technical Committee for the Hydrometeorological Survey of Lakes Victoria, Kyoga and Mobutu Sese Seko - Burundi, Egypt, Kenya, Rwanda, Sudan, United Republic of Tanzania, Uganda	1967
Senegal	Organisation pour la mise en valeur du fleuve du Senegal (OMVS) - Mali, Mauritania, Senegal - Dakar (Senegal)	1968
Tanganyika	Inter-State Technical Committee for the Development of the Water Resources of Lake Tanganyika Basin - Burundi, Rwanda, United Rep. of Tanzania, Zambia, Zaire - Bujumbura (Burundi)	

(v) UNEP/WMO Background Air Pollution Monitoring Network (BAPMoN)

This is the world's largest air monitoring network with background air pollution monitoring stations in many African countries established jointly with the national meteorological services;

(vi) UNESCO/Man and Biosphere programme

This programme is actively involved in Africa with environmental education and provision of information to member States on environmental aspects of human interaction with nature.

103. There are several intergovernmental agencies, UN agencies and specialized international organizations that are actively involved at national, subregional and regional levels in re-forestation, land reclammation, afforestation, fixation of sand dunes, soil conservation, land and water development, range management, and environmental education and information.

Co-ordination of national environmental standards

104. Activities on environmental protection and pollution control are generally co-ordinated separately or collectively by governmental institutions, such as ministries of the environment, departments of the environment, commissions, councils and academies responsible for the environment, or related department/ministries which cover environmental activities. Minimum standards on various commodities, service, operations and controls are the central responsibilities of National Standards Bodies (NSBs) whilst the implementation of environmental standards, codes and regulations are the responsibility of institutions dealing with environmental activities at national levels.

105. The constitutions of most National Standards Bodies require that all standardization activities at national level be co-ordinated by these institutions. In practice, it is observed that the long established institutions such as the electricity supply authorities, water supply authorities and government departments responsible for the control of pesticides, water development, industrial activities continue to develop standards for their operations and services without any collaboration with National Standards Bodies which possess the necessary technical know-how and expertise for the development on national standards. As a result, in many developing countries where human as well as financial resources are scarce, one observes a conflict of interests, and a wasteful duplication of efforts in the fields of standardization and quality control. Such duplication of efforts and proliferation of the same activities in several government departments and institutions are the chief causes of conflict and misallocation of scarce resources. Unless action is taken to reorganize, restructure, and streamline such operations, human and financial resources will continue to be misallocated and misused with very serious consequences on the socio-economic development of the countries concerned.

106. Several countries in Africa have recognized the importance of environmental protection and pollution control. Several countries have established national commissions, councils or academies for the environment, departments of the environment and in some

very few cases ministries of the environment, without much consideration for co-ordination of environmental activities between the different ministries involved. The emergency of national standardizing bodies as the sole authorities entrusted with the central responsibilities for standardization, quality control and metrology creates a serious conflict of interests with the national environmental coordinating bodies. Also there is fear in the case of other institutions whose products, services and operations are to be standardized, because of likely loss of authority and power over those activities. This need not be the case because the National Standards Bodies are normally expected to liaise with other institutions at national level in the development of national standards of special interest to those institutions. The National Standards Bodies (NSBs) can only be expected to ensure that the standards so developed should be implemented by the relevant authorities. It is only in cases where no relevant authorities exist at national level that facilities are developed within the National Standards Bodies for the implementation of national standards.

C. Detailed discussion on missions to four selected member States

107. The plan required that the study be conducted in Egypt, Ethiopia, Kenya, Botswana, and Zimbabwe. Due to reasons of timing and programming of the mission, the study was finally scheduled for Egypt, Ethiopia, Kenya, Malawi and Zimbabwe. In all countries except Zimbabwe, the National Standards Bodies were the focal points organizing the national itinerary for the consultant. In Zimbabwe, for some unknown reasons the consultant had to arrange some of the contacts in addition to those by the Ministry of Industry and Technology.

108. The detailed discussion of the mission findings is divided into five main subjects, namely:

(a) General information
(b) Air pollution and weather forecasting
(c) Water pollution and sanitation
(d) Land pollution and ecological degradation
(e) Maintenance of environmental standards

General information

109. Ethiopia is basically an agricultural country earning nearly 75 per cent of its foreign income from the export of agricultural products as shown in Table XVIII. Ethiopia is in the Sudano Sahelian belt and is currently undergoing the most devastating effects of drought in years. The country is now on the emergency aid list of many aid agencies and countries. Thousands in the drought stricken parts of Ethiopia are environmental refugees getting food, clothes and medicines. Ethiopia has a population of 33.8 million (1983) and its income per capita of $131 which is among the lowest in Africa.

110. Egypt is geographically a desert and all its population is concentrated in oasis and along the valley of river Nile which threads its way from Sudan in the south through Egypt to the Mediterranean Sea in the north. It has a population of over 45 million people most of which live in urban and semi-urban settlements. Nearly 70% of Egypt's total exports are from the mining industries, namely: crude petroleum, petroleum products and aluminium as indicated in Table XIX.

111. Zimbabwe is located between the Limpopo river to the south and Zambezi river to the north and has a population of 8.2 million people. It is politically a young nation but has an abundant supply of mineral resources (except oil) and well developed commercial, agricultural and industrial sectors. Its colonial background significantly contributed to such significant sectoral developments. Up until independence in 1980, the commercial and agricultural sectors were almost entirely in the hands of a relatively small number of European farmers using modern techniques (machinery, fertilizers, etc). Tobacco is the principle cash crop although beef, cotton and maize are also important. Table XX shows the country's major exports.

112. Malawi is basically an agricultural country with a population of 6.8 million people. It ranks amongst the densely populated countries. One tail of the great rift valleys of Africa passes through Malawi where Lake Malawi, Lake Malombe and the Shire river are found. Nearly 44% of Malawi is land, over 12% is slope. Table XXI shows the major exports of Malawi. Despite its size, Malawi is known to be self-sufficient in food production.

Air pollution and weather forecasting

113. The establishment of meteorological services in the countries visited was initially for the purposes of forecasting for the civil aviation purposes. Most of the meteorological services do not deal with industrial air pollution activities. Their main duties include obtaining agrometeorological data and monitoring background air pollution and baseline air pollution in conjunction with the WMO. Air pollution monitoring in the case of Zimbabwe is the responsibility of the Ministry of Health through the Air Pollution Prevention Act, 1971. The following state-of-affairs was observed during the mission in respect of air pollution control activities:

(a) Egypt has very serious air pollution problems emanating from motor vehicles exhaust emissions, domestic cooking, industrial activities and dust from the surrounding desert. The Nile Valley, a depression in the desert, runs the danger of temperature inversion and serious health hazards to the valley inhabitants. Because of these problems, Egypt now has a well established National Research Centre where research on air and other forms of pollution and environmental health hazards are conducted.

(b) The Meteorological Authority in Egypt is mostly involved in background pollution measurements under UNEP/WHO BAPMON programme through its three stations at Sidi Barrani near the Mediterranean Sea, at Oasis Siwa in the Western desert and at Hargada along the Red Sea. The precipitation and other samples collected

Table XVIII: Exports (1980): Ethiopia

Commodities	Value (x1000$)	% of Country	% of Developed	% of World
All commodities	378040	100.0	0.07	0.02
Coffee	226986	60.04	2.76	2.47
Hides, skins, undressed	47504	12.57	13.18	1.90
Petroleum products	29920	7.91	0.08	0.03
Vegetable, etc. fresh simply preserved	14908	3.94	0.57	0.19
Oil seeds, nuts, kernels	13963	3.69	0.74	0.14
Crude vegetable materials	9062	2.40	0.82	0.19
Cotton	8398	2.22	0.28	0.12
Sugar and honey	5811	1.54	0.07	0.04
Animal feed stuff	3819	1.01	0.10	0.03
Meat, fresh, chilled, frozen	3610	0.95	0.16	0.02
Live animals	3576	0.95	0.48	0.07
Coin, non-gold, non-current	2688	0.71	3.46	1.42
Spices	1595	0.42	0.21	0.17
Processed animal vegetable oil, etc.	1248	0.33	0.55	0.11
Crude animal matter	1247	0.33	0.31	0.09
Remainder	3725	0.99	-	-

Source: Handbook of International Trade and Development 1984 Supplement.

Table XIX: Exports (1981): Egypt

Commodities	Value (x1000$)	% of Country	% of Developed	% of World
All commodities	3232181	100	0.60	0.16
Crude petroleum etc	1757895	54.39	0.64	0.56
Cotton	477391	14.77	15.82	6.58
Petroleum product	324335	10.03	0.85	0.35
Textile, yarn, thread	157210	4.86	5.52	1.25
Aluminium	132193	4.09	9.60	1.17
Fruit fresh nuts, etc	52878	1.64	1.38	0.57
Vegetable etc. fresh, simply preserved	46975	1.45	1.81	0.58
Rice	42608	1.32	1.76	0.85
Cotton fabrics, woven	33635	1.04	1.57	0.51
Sugar and honey	26638	0.82	0.33	0.13
Clothing not for fur	22171	0.69	0.14	0.08
Live animals	18532	0.57	2.48	0.36
Vegetables, etc (preserved prepared)	10490	0.32	1.42	0.36
Crude vegetable materials	10131	0.32	0.92	0.21
Fruit preserved, prepared)	9625	0.30	0.62	0.23
Remainder	109414	3.39	-	-

Source: Handbook of International Trade and Development 1984 Supplement.

Table XX: Exports (1981): Zimbabwe

Commodities	Value (x1000$)	% of Country	% of Developed	% of World
All commodities	1320785	100	0.25	0.07
Pig iron, etc	370636	28.06	32.70	8.41
Tobacco unmanufactured	259079	19.62	13.81	6.50
Sugar & honey	165824	12.55	2.04	1.20
Nickel	133872	10.14	31.66	5.49
Other crude minerals	78437	5.94	10.15	1.92
Maize unmilled	54604	4.13	2.97	0.46
Coal, coke, briquettes	39012	2.95	45.56	0.22
Cotton	30701	2.32	1.02	0.42
Iron and steel shapes	27000	2.04	2.48	0.21
Iron steel primary forms	15419	1.17	2.62	0.23
Meat fresh, chilled, frozen	13930	1.05	0.63	0.09
Textile, yarn and thread	13436	1.02	0.47	0.11
Tin	8712	0.66	0.37	0.32
Hides, skins, undressed	8405	0.64	2.33	0.34
Mail not class by kind	8265	0.63	7.69	0.65
Remainder	83413	7.07	-	-

Source: Handbook of International Trade and Development 1984 Supplement.

Table XXI: Exports (1981) Malawi

Commodities	Value (x1000$)	% of Country	% of Developed	% of World
All commodities	261588	100.00	0.05	0.01
Tobacco manufactured	110286	42.16	5.88	2.77
Sugar and honey	68240	26.09	0.84	0.49
Tea and mate	33938	12.97	2.58	2.20
Oil seeds, nuts, kernels	13145	5.02	0.70	0.13
Cotton fabrics, woven	10718	4.10	0.50	0.16
Rice	3406	1.30	0.14	0.07
Vegetables etc. preserved, prepared	2518	0.96	0.34	0.09
Coffee	1783	0.68	0.02	0.02
Clothing not for fur	1658	0.63	0.05	0.02
Fish fresh, simply preserved	1587	0.61	0.03	0.01
Textile, yarn and thread	1290	0.49	0.05	0.01
Animal feeding stuff	1155	0.44	0.03	0.01
Footwear	1016	0.39	0.03	0.01
Textile etc. products	878	0.34	0.07	0.02
Remainder	8239	3.15	-	-

are sent to Vienna, Austria, for analysis at the International Atomic Energy Authority laboratories as recommended by the WMO. The authority has no laboratories of its own. The future developmental plans of the authority include the establishment of mobile stations to monitor motor vehicles exhaust emissions in Cairo and all other industrial and commercial cities in Egypt.

(c) The National Meteorological Services Agency of Ethiopia was established as a semi-autonomous organization in 1980. Prior to that it was in Civil Aviation. The agency publishes a Monthly Weather Report, Ten-Day and Monthly Farming Weather Bulletin, Seasonal Farming Weather Bulletin, and a Seasonal Hydrometeorological Bulletin. Special publications of various types, including a special warning on precipitation (three in 1984 on drought) are prepared and distributed. The agency has not been involved in industrial air pollution control since establishment. However, in 1983, an expert mission concluded that air pollution is not a field that warrants immediate attention. No laboratory facilities exist in the agency except those instruments for collecting samples at the WMO Regional Air Pollution Background Station at Baherda.

(d) Zimbabwe has an Air Pollution Control Unit which is located in the Ministry of Health and operates under the mandate of the Atmospheric Air Pollution Control Act of 1971. The Unit has so far developed the following regulations to enable it to implement the provisions of the Act:

(i) Atmospheric Pollution Prevention (Control of Emissions) Regulations, 1977;

(ii) Atmospheric Pollution Prevention (Smoke Control Areas) Notice, 1983;

(iii) Atmospheric Pollution Prevention (Dust Control Area) Notice, 1983;

(iv) Atmospheric Pollution Prevention (Gas Control and Specified Processes), Notice 1974

(v) Atmospheric Pollution Prevention (Smoke Control) Regulations, 1975.

(e) Notable amongst the emittors of toxic air pollutants and odorous gases in Zimbabwe are:

(i) Chemplex (Fertilizer plant), Harare - SO_2;

(ii) Cold Storage Commission (Meat products), Harare, Odour;

(iii) Chloride Batteries, Harare - Lead fumes;

(iv) Nickel Smelter, Bindura - SO_2, fumes;

(v) Union Carbide, Kwe Kwe - SO_2, fumes

(vi) Zimbabwe Railways, Bulawayo - SO, fumes, organics;

(vii) Electricity Supply Commission (Power Station, Thermal), Harare - gases, organics;

(viii) Quarries (all over the country) - dust;and

(ix) Hwange Colliery - fumes, dust, gases.

Jointly with the Meteorological Services Department, the Unit established a network of gas detectors in order to observe the nature and type of air pollution prevalent in specific areas including human settlement areas. Samples are tested at the Government Analyst's Laboratories but results are almost always reported late.

(f) The Meteorological Services Department in the Ministry of Energy, Water Resources is involved in obtaining agrometeorological data and monitoring changes in climatic and weather conditions for civil aviation purposes. The department was established more than fifty years ago and in the early 1960s,it was upgraded to serve then that was to be the Federation of Rhodesia and Nyasaland (grouping what now is Zimbabse, Zambia and Malawi). It is the largest meteorological services institution in SADCC (Southern African Development Co-ordinating Conference) subregion and it is proposed by a survey mission sponsored by WMO to act as a SADCC regional centre for meteorological services. The Department publishes a monthly Meteorological Summary that dates back 50 years as well as a weekly Precipitation and Temperature Bulletin.

(g) In Malawi, the Department of Meteorological Services is in the Ministry of Transport and Communications and is basically involved in obtaining agrometeorological data and climatic and weather conditions for civil aviation purposes. It produces ten regular and irregular publications, namely: the Monthly Rainfall Bulletin, a Ten-day Agrometeorological Summary, a Monthly Agrometeorological Summary and an Agroclimatic Aspect of the Growing Season. The department is not involved with the control of air pollution arising from domestic and industrial activities and has no laboratories of its own.

114. Observations have indicated that there is very little effort taken in the monitoring and control of air pollution in urban areas in Africa except background air pollution monitoring in a number of African countries. No institutional arrangements exist in most African countries for testing air samples. Most National Standards Bodies in many countries in Africa have not developed national standards on air pollution prevention and facilities for monitoring atmospheric pollution.

Water pollution and sanitation

115. Some of the human suffering in Africa today is caused by poor sanitation and persistence of water-borne and environment-related diseases. Safe drinking water supply and adequate sanitation facilities can alleviate human suffering in Africa. The general observations during the mission are that no institutional arrangements exist in some of the African countreis even to provide enough drinking water, let alone safe drinking water, and sanitation facilities in cities and to the rural community. The extent to which these facilities are made available depends upon circumstances such as availability of ample raw water supply, the technology used in the treatment of water (and spare parts), the traditions and culture of the people, and the legislations that control the water development and sanitation activities.

116. The following are some of the institutional arrangements which exist in the monitoring and prevention of water pollution in the countries visited:

(a) Egypt relies upon the Nile as the source of all its water for drinking, irrigation and industrial processes. The Nile River also receives all the liquid effluents from domestic and industrial activities. The supply of water in Egypt depends upon the climatic conditions in Sudan, Ethiopia and the region around Lake Victoria. The Aswan Dam has been extremely useful to Egypt in supplying water during these periods when the water level of the Nile has been very low due to drought conditions in Sudan and Ethiopia - the catchment areas for the White and Blue Nile.

(b) The National Research Centre in Egypt is a semi-autonomous body operating under the Academy of Science and Technology. The Research Centre has links with universities and conducts research leading to advanced degrees awarded by the local universities. The Centre has an Environmental Research Department where research on water pollution and occupational health, in addition to air pollution is conducted. The Academy provides most of the funds for research projects conducted. The Centre conducts the following research activities in the field of water pollution control:

(i) Waste water treatment - The centre has a pilot water treatment plant for research purposes;

(ii) Bacteriological studies - Some of the studies are conducted to establish the efficiency of water treatment plants. Virological studies are also part of these studies;

(iii) Heavy metals monitoring - Studies are conducted to evaluate concentrations of salts of toxic heavy metals in rivers as well as the raw and treated waters. Traces of these elements are also determined in agricultural crops;

(iv) Pesticide residues - Studies are conducted on pesticides residues in water, sedimentation, and aquatic flora and fauna in order also to evaluate the efficiency of methods used in removal of these pesticides during water and effluent treatment.

(v) Oil pollution - Studies are conducted on inland waters and coastal areas of the Mediterranean Sea and the Red Sea to determine oil pollution from water vessels, waste oil leakages from tankers, etc.

The centre has adequate manpower and facilities to conduct research in water and air pollution problems. The centre also conducts research studies on occupational health problems.

(c) The Water Supply Organization in Cairo supplies water to nearly 12 million inhabitants of Greater Cairo. The standards followed in the treatment of drinking water are those developed by the Egyptian Organization for Standardization (EOS) and the Environmental Health Department. The main problems faced by the Organization are:

(i) The presence and/or over growth of algae in water supply reservoirs which might lead to putrefaction and odour;

(ii) Minute traces of ammonia and nitrites in water produce nitric acid which may corrode metal piping;

(iii) Effluent from industries containing salts of heavy metals and traces of petroleum products render water treatment complicated and expensive.

Research is being planned at its Central Laboratory to assess the effects of chlorination and total elimination of organo-chlorine compounds most of which are known to be carcinogenic. The laboratory needs modern water testing equipment such as a gas liquid chromatograph, an atomic absorption spectophotometer, etc.

(d) The Greater Cairo Sewage and Sanitary Drainage Organization has the responsibility for treating sewage and disposing solid waste in a manner that does not cause pollution or health hazards. Some of the problems the organization faces are:

(i) the production of hydrogen sulphide in sewer pipes under anaerobic conditions leads to the production of sulphuric acid which is highly corrosive to metal and concrete piping or tanks. This problem is created due to the accumulation of solids along sewer pipes without an acceptable gradient to allow gravitational flow of sewage to the treatment plants;

(ii) rehabilitation of gravity sewers made of concrete is very expensive. Special clay, bricks, high alumina cement and high density polythene sheets are used to rehabilitate the sewers.

The present project under which bigger sewage treatment plants are being installed is expected to be completed by 1981 and the treated liquid effluent will be used for irrigation and the solid waste for land reclamation purposes. Current research is being conducted on the environmental impact of heavy metals accumulating in plant and crop tissues. But the department lacks modern equipment for testing treated effluent and performing research in special fields.

(e) The Addis Ababa Water and Sewage Authority provides water to nearly one million people in the city. The Authority is also responsible for waste disposal and sewage treatment operations. It was observed that efforts are made to provide clean drinking water. At best, the clean chlorinated water from treatment plants is rendered unsafe for drinking purposes when it comes into contact with contaminated pipe network that conveys water to consumers and at worst, the water is not available some of the times during the day. This Authority has its own regulations and bye-laws that contain water standards and effluent standards to govern its water treatment and sewage treatment processes. There is, however, very little liaison with other institutions involved in water quality control and testing.

(f) The Environmental Health Department in Ethiopia is under the Ministry of Health and is engaged in:

- the food and beverage control;
- industrial and occupational hygiene;
- housing and solid waste management;
- general sanitation, and
- water and waste water control.

It operates under very old rules and regulations which were established when Ethiopian cities were mere towns and industrial pollution was never a serious threat to human, and animal health and to the ecological balance. Efforts were made to revise the regulations in 1971 and the draft regulations are still awaiting government approval. Due to technological advancements since 1971, these draft regulations are due for a review. Although the department is responsible for water and waste water control, there has been little activity in this field due to lack of cooperation with other bodies also legally entrusted with the responsibility for water supply and its quality control. The main problems the department faces are summarized below:

(i) water supply systems are provided by other authorities;

(ii) lack of enabling legislation to force the water providing authorities to comply to the draft Environmental Standards on Drinking Water or the International Drinking Water Standard set by WHO;

(iii) there is a prevalence of feacal and water-borne communicable diseases which constitute 75 per cent of the health problem of the country. Most of these diseases can be prevented through proper environmental sanitation and health education;

(iv) there is need to teach good sanitary practices to the slum and squatter settlements in urban areas as well as to the rural population;

(v) there is no control of industrial effluent pollution;

(vi) lack of Ethiopian drinking water standards; and

(vii) already half way through the International Water Drinking Supply and Sanitation Decade 1980 - 1990 and yet there is much work to be done.

(g) The Public and Environmental Health Planning Department in Ethiopia is established under the Water Resources Authority and is charged with the task of conducting studies concerned with health and related activities. The Department ensures that considerations for public and environmental health are made when water resources development for irrigation and hydroelectrical energy are being planned. The pollution threat posed by pesticides and fertilizers although no studies have been done, is very serious and the likely sources of pollution are mechanized agricultural activities in Lower Awash Valley where huge quantities of fertilizers and pesticides are used. There is a small laboratory with basic equipment and chemicals for supportive purposes only. By nature of the Department's objectives, this laboratory has great potential if strengthened sufficiently with appropriate water testing equipment and trained manpower. The regulations being used are now out-of-date and are due for review and revision. Collaboration with other institutions is being promoted through a multidisciplinary approach to public health currently launched. Under this approach, it is expected that national problems such as, malaria control, bilharzia control, cholera, etc. can be tackled through a dynamic committee comprising the Biology Department of the University, Water Resources Authority, Malaria Control Programme and others. Major problems exist in the field of collaboration amongst institutions in Ethiopia dealing with water quality, health and sanitation, quality control of water and food products, and so on.

(h) The Ethiopian Standards Institutions (ESI) is legally entrusted with the task of development of standards and their implementation through certification and has a nucleus of a food quality control laboratory which needs strengthening. The proposed transfer of the Industrial Chemistry Department of the Central Laboratory and Research Centre to the ESI will significantly strengthen the role of the ESI whilest also improving its revenue. The Central Laboratory and Research Centre will continue with its other testing activities and plans to establish a Sanitary Chemistry Department which is expected to deal mainly with public health questions.

(i) The Sewage Works of the Department of Works of the Municipality of Harare, Zimbabwe is responsible for the waste disposal and effluent treatment activities. Water pollution was not considered a serious threat to human and animal health for many years until 1957 when lake Macllwaine was commissioned. Untreated or poorly treated effluent discharged into rivers Makabusi and Marimba found its way into the dam. The effluent caused the growth of water hyacinth (Eichornia crassipes) and algae blooms which interfered with the natural biochemical purification process. This led to eutrophication odours and unsightly appearance. Hydrobiological research on the lake conducted by the University of Zimbabwe, in 1970, revealed the presence of large quantities of nutrients (mainly nitrogen and phosphorus) in lake sediments and were constantly being added (mainly phosphorus) from non-point urban and agricultural sources. Corrective measures were taken, weeds destroyed and steps taken to reduce further pollution by disposing the treated effluent, previously discharged into the lake, by irrigation on land. Then Water Pollution Regulations were developed in order to protect water courses from main sources of pollution, namely, industrial

activities and human settlements. Human settlements with no adequate effluent and solid waste disposal facilities and adequate water supplies, present special problems to any local authority. Slum and squatter settlements are very common in urban areas of Zimbabwe. Since Epworth Squatter Camp and the Airport are not connected to the main sewer pipes, some effluent gets washed into wells, contaminating underground water supply to render boreholes and well water unsafe. In Harare, two main methods are used in sewage treatment:

(i) the Biological Nutrient Removal Process which is said to reduce BOD, Phosphates and Nitrates. Up to 30% water is recovered and discharged into rivers and streams;

(ii) Modified Activated Sludge Process where aerated and activated sludge is mixed with sewage and the mixture thoroughly agitated. During the process, solids in the sewage coagulate into more sludge whilst aerobic bacteria continue to decompose the sewage. This process is considered to be more effective in sewage treatment than the first process. The solid effluent settles and the clear liquid effluent is removed and can be discharged into rivers and streams. Some of the sludge is retained for aeration and future addition to incoming sewage while the balance is disposed of by digestion.

(j) Water Pollution Control Unit in the Ministry of Health co-ordinates the overall water pollution control activities in Zimbabwe. The Unit has stationed permanently Water Pollution Control Technicians in Mashonaland, Manicaland, Matebeleland, Middleland and Masvingo provinces. It is responsible to the Water Pollution Control Board comprising twenty five members drawn from government, public, and private sectors. The Unit has 150 permanent sampling points distributed throughout the country. Samples collected at specified time at all these points, selected because of their strategic positions in providing useful information on the extent of pollution up-stream or in the underground water reservoirs are analysed at the Government Analyst's Laboratories. Sewage works, industries, etc. are sampled directly as they produce huge quantities of effluent. It was observed that most of Zimbabwe's industries are in big cities and sewage works near rivers and streams. Industries nowadays are being established throughout the country. Effluent standards adopted in the country are more stringent than those in Europe and America because many of the rural communities use water from rivers, wells and boreholes. Stringent standards had to be established to protect the rural community using water from rivers, wells and boreholes. Stringent standards were established to protect the rural community which is more vulnerable to the effects of pollution than the urban community using piped water. For every new factory, or new sewage works, details of effluent treatment are sent to the Unit which prepares recommendations for action by the Water Pollution Advisory Board. Before the recommendations are made, inspection of the premises and sampling of effluents at points before flowing into water courses are made and tests are conducted. Awards of permits are made only to companies which have indicated specific plans to take corrective measures within specified period. Habitual

offenders are refused permits and are even prosecuted if they continue to ignore the regulations. During the drought period, many companies installed equipment for effluent treatment and up to 70% of water was recycled from effluent. Such pollution abatement equipment are now being used to pretreat effluent before discharge into water courses.

(k) The Sewage and Pollution Control Unit of the City of Blantyre, Malawi, is responsible for the industrial effluents in its sewage treatment plants. There are three major and two minor treatment plants located in the strategic areas of the human settlements in the City of Blantyre. Big industries are required to establish their own effluent pre-treatment systems such as oxidation ponds or settling tanks combined with biological filters, etc. to treat the effluent to required standards before discharge into the sewers. Garages that generate quantities of used oil waste are required to instal oil interceptors in order to prevent oil from being discharged into the main sewers. The unit has a small laboratory and will soon move into a new laboratory established to test the efficiency of treatment at industrial and sewage plant levels. The Health Department of the City of Blantyre to which the section belongs is responsible for the sanitation and health of the city inhabitants. There are no standards for air and land pollution and the bye-laws governing the discharge of industrial effluent into sewers are not explicit and need review. The Act is general and does not provide adequate measures. The department conducts routine inspections of houses, playfields, housing estates, cinema halls, etc. in order to maintain highest standards of sanitation and safety. Similarly, there is regular street cleaning, refuse collection in the developed parts of the city, and health educators visit families in the traditional housing areas and squatter estates to educate them on sanitation, nutrition and child care.

(l) The Blantyre Water Board in Malawi is a parastatal body of Government charged with the responsibility for providing clean water to the City of Blantyre and the surrounding areas. The Board obtains its water from the Shire River nearly fifty kilometres away at Walker's Ferry. The Mudi and Hinde Dams in Blantyre are standby water reservoirs along the Mudi river. The catchment areas is fenced to protect the water reservoirs from human pollution. The Board now provides piped water to all slums and squatter settlements. One water Kiosk is constructed to serve 500 people. The water is treated following the WHO recommended standards. All people coming into contact with water treatment plant are required to undergo clinical examinations once every month in order to reduce water pollution during or after treatment.

(m) The Zomba Sewage Works Unit in Malawi is in charge of processing sewage in the Municipality of Zomba and in Liwonde Township. Conventional Treatment Process is used in Zomba which involves the following stages:

(i) Preliminary treatment (Grit Chamber) - where grit and other materials are removed;

(ii) Primary Settlement Tanks - where separation of solid and liquid effluent occurs;

(iii) Filtration - This step has three main components:

1. Biological filters (Aerobic Treatment process) depend on aerobic bacteria to digest the organic matter and it is where 60% of the toxicity of the effluent is removed.

2. Final Settling Tanks - where unfermented organic and inorganic suspended solids settle leaving a clear liquid effluent.

3. Ponds (Maturation Ponds) where final aerobic treatment occurs before the treated effluent is discharged into the water bodies. These maturation ponds are generally shallow to allow convectional current caused by temperature differences to introduce oxygen which sustains aerobic treatment process.

(iv) Digestion - the sludge which separates in the final settling tanks is pumped into digesting tanks where it undergoes anaerobic fermentation. The final solid is dried and used for agricultural purposes. At Liwonde Township, oxidation ponds are used in sewage treatment. They are simple to maintain and equally effective in sewage treatment. The sewage is discharged into the first pond (facultative) where both aerobic and anaerobic processes occur. The effluent sediments into the liquid and solid layers. In the top and bottom layers simultaneous aerobic and anaerobic reactions occur, respectively. The liquid effluent then flows into the other three ponds where the aerobic reaction completes the treatment process and the treated effluent discharged into the water course from the fourth pond.

(n) The City Engineer's Department of Lilongwe, Malawi, is responsible for the operation of several sewage treatment plants. The sewage system in the old town was designed to handle sewage from only 15,000 people. The expansion of the city since it became the capital of Malawi in 1975 put severe strains to the waste disposal and sewage treatment system. There are several mechanical plants and oxidation ponds in strategic points to handle sewage from various industrial and commercial areas, and housing areas. The main problems experienced are:

(i) Where breakdowns of plants occur, lack of spares and delays in importing them lead to discharge of raw sewage into the rivers,

(ii) Oxidation ponds operated by others due to negligence are found to putrefy and to generate odour which is a nuisance in the neighbourhood.

Plans are underway to expand the sewage system in the City. Since the City has enough land, it is anticipated that plans to have a comprehensive sewage system based on oxidation ponds will be accepted.

(c) The Water Resources Board in the Ministry of Works and Supplies in Malawi is entrusted with the responsibility of water resources development and conservation by the Water Resources Act of 1971. The problems the Board faces in implementing the Act are:

(i) there are no specific regulations established to guide the issuance of permits to estates, industries and other institutions to abstract underground or surface water. Similarly, there are no regulations to follow in the case of non-compliance with the conditions under which the permits are issued;

(ii) the Board has inadequate staff deployed to implement the provisions of the Act at national level;

(iii) the standards or limits for industrial effluent in current use are not being observed and thus water pollution control activities are inappropriate as means of protecting the Malawi environment;

(iv) the laboratory established to test water samples is small and would not cope with a comprehensive water pollution monitoring and control system testing samples collected from all the rural and urban water courses.

(d) Land pollution and ecological degradation

117. Commercial agriculture using modern techniques (machinery, fertilizers, pesticides and irrigation) has been one of the major causes of land pollution although waste or refuse disposal is a serious environmental problem in most African countries. Pesticides and fertilizers applied in commercial agriculture contaminate the soil and water courses and excessive nutrients of the nitrogen and phosphorous type, disturb the aquatic ecosystem by accelerating algal growth and the growth of water hyacinth which by depleting dissolved oxygen lead to eutrophication. Irrigation leads to salinization of the land and eventually renders the soil incapable of supporting crops and vegetation. Poor agricultural practices, deforestation, and poor livestock management, etc. have contributed to the worsening drought conditions and encroachment of deserts in many parts of Africa.

118. The ministries responsible for agriculture, natural resources, energy and water resources and development, or forestry are responsible, in one way or another, for the conservation of soil and proper crop, land, and animal husbandry. In Egypt, the main problem has been the land conflict between agriculture, housing, industries, etc. along the Nile valley and the continuous use of good agricultural soil for brickmaking. Action now has been taken to ban brickmaking using clay. Instead sand bricks are promoted. The absence of forests especially on the edges of the valley to act as wind and dust shields creates a persistent dust pollution problem affecting agricultural land, buildings and water courses.

119. Commercial timber harvesting in Ethiopia, Kenya, Malawi and Zimbabwe has continued without any form of replacing the indigenous timber with indigenous seedlings during re-forestation programmes and has been partly responsible for the climatic changes experienced in recent years. Bush fires as explained in earlier paragraphs can, over a period of time, reduce soil cover and cause soil erosion, land degradation, floods, and droughts and eventually desertification. In Zimbabwe legislation has been passed banning bush fires because of their effects on vegetation and the natural environment.

120. Zimbabwe has also passed a Fertilizers, Farm Feeds and Remedies Act which empowered the Plant Protection Research Institute of the Department of Research and Special Services to control the inflow of all agricultural chemicals and fertilizers through a registration system. The purposes of registration is to ensure safe and efficient use of pesticides in the interests of:

(a) the user who is concerned with the efficiency of the chemical and its hazards in handling;

(b) the consumer who is concerned with possible residues in food,

(c) the general public who are concerned with such hazards as drift, contamination of water courses and loss of wild life;and

(d) the vendor who should be protected from unsound or unfair claims for competitive products.

Before a pesticide can be registered, a manufacturer or importer is required to provide technical information (specification) and an experimentation sample. An importer is expected to conduct trials and where this is not practicable the Institute conducts the trials. Trials on pesticides for use by other specialized institutes are handled by those institutes. Assessment of the biological efficacy of pesticides and toxicity tests are conducted in order to classify into appropriate colour codes for the benefit of users. A colour is assigned to each commercially available pesticide based on:

(a) acute Oral LD_{50} of the technical material;

(b) the strength of the formulation,

(c) the persistence of the pesticide after application; and

(d) other relevant data.

The colours used are green, amber, red and purple with green and purple representing the less toxic and very toxic, respectively.

121. The Land Husbandry and Pests and Diseases Control Sections in the Ministry of Agriculture in Malawi are actively involved in land conservation and crop protection activities. The Ministry of Agriculture has programmes, through its Extensions Services Unit and Environmental Education Unit, to create awareness of good land husbandry, for instance:

(a) Erosion consciousness - small holder and rural farmers are taught to be erosion conscious and that trees must be replaced wherever they have been harvested. Non-arable land which includes rocky patches and steep slopes must be used for woodlots;

(b) Biological and physical techniques in land husbandry help to protect the soil fertility and prevent soil erosion;

(c) Keeping manageable number of livestock will reduce soil degradation through overstocking and overgrazing;

(d) For estate commercial farmers, they are required to afforest 10% of the land under cultivation;

(e) A land husbandry manual has been produced for the use in Malawi which is comprehensive and has been commended by many subregional organizations;

(f) The Wood Energy Unit supplies tree seedlings freely for village woodlots and to schools and others during the National Tree Planting Day in January each year.

Since there is no legislation regulating the importation and use of agricultural chemicals, the government controls pesticides that are used by smallholder farmers through a system similar to that used in Zimbabwe but has no control over those used by larger estate farmers.

122. Mining Operations in Zimbabwe have been found to cause serious environmental pollution and ecological degradation. The fumes, gases, dust and smoke emitted pollute the air and land, the liquid effluents pollute the rivers and lakes, and the solid waste become a nuisance if not properly disposed. The Natural Resources Board jointly with the Ministry of Mining organize annually a competition aimed at identifying which mine has taken outstanding measures in the reduction of environmental pollution and ecological degradation. The response has been so encouraging that nearly all mines participate in the competition and now a dump hill at Mangula Mine in Mangula, Lomagunde District, is 90% covered with vegetation.

(e) Maintenance of standards

123. In the countries visited during the study there existed well established National Standards Bodies whose central responsibilities are to develop and promote the implementation of national standards at the national level. The level of development, range of activities and number and types of standards promulgated depended upon prevailing national priorities for social and economic development.

The Standards Association of Central Africa (Zimbabwe)

124. This is well developed and more inclined to engineering and mining standards. This was established in the late 1950s to cater for the unsuccessful and now defunct Federation of Rhodesia (now Zimbia and Zimbabwe) and Nyasaland (now Malawi). They handle increasing numbers of water samples since the Government Analyst's Laboratories are getting inundated with samples from government ministries and departments.

Malawi Bureau of Standards (MBS)

125. This institution has developed relatively few standards compared with the period it has been in operation. However, the MBS has well developed laboratory capabilities especially in the monitoring of pesticide residues in tobacco. There are no physical testing laboratories and work in this field is done outside the country. The MBS is capable of maintaining environmental standards if additional inputs in the form of laboratory equipment, manpower and training are made.

The Egyptian Organization for Standardization and Quality Control (EOS)

126. The EOS is by far the largest national standards body in black Africa and has been in operation for over 25 years. Since Egypt has more industries and mining operations, the EOS has developed to meet the needs of such industries. It has developed hundreds of national standards of which a good proportion is in the mining, manufacturing and petroleum fields. The EOS has no laboratory facilities for testing water although it has developed some standards on water quality. Development of laboratory facilities in water and air quality testing would be beneficial for the maintenance of environmental standards in the country.

Ethiopian Standards Institution (ESI)

127. The ESI has been in operation since 1974 and has experienced rapid expansion over the years. With the recent UNIDO Project, the ESI has moved into a custom built building and will instal laboratory equipment for various quality control activities. The ESI is also receiving the Industrial Chemistry Department from the Central Laboratory and Research Centre in a move by government to restructure and rationalise operations. The Industrial Chemistry Department handles nearly 30% of samples of the Research Centre of which most are water and food samples.

National Committee for the Environment NCE of Malawi

128. Malawi has established a National Committee for the Environment with the central responsibility to:

(a) undertake overall responsibility for considering all on-going and proposed activities in Malawi in order to ensure that damaging effects on the environment will be minimized or reversed, consistent with sustainable development;

(b) to formulate [illegible]

(c) to resolve conflicting proposals from bodies and individuals undertaking activities which impinge upon the environment, or to seek a decision from the Cabinet when the conflicts cannot be resolved by the National Committee for the Environment;

(d) to pass on the decisions to the implementing organizations and to ensure that the decisions are complied with;

(e) to set up and administer an appropriately staffed and equipped permanent Secretariat for environmental matters to enable the Committee to discharge its responsibilities.

This NCE has now been in operation for two years and has established a Secretariat in the Ministry of Forestry and Natural Resources. Membership to the NCE is at chief executive officer's level of institutions appointed to serve in the Committee.

D. Analysis of completed questionnaires received from ECA member States

129. At the time the report was being prepared no returns of questionnaires had been received except those completed by member states visited during the mission. An examination of the questionnaires completed during the visits provide the information that has already been discussed in detail in paragraph 104 above. In view of the importance of the questionnaires, it may be worthwhile to make the analysis later when completed questionnaires have been received by ARSO. This may be the subject to be included in the Programme of Activities for the development of African Regional Standards for environmental protection.

CHAPTER 2

PROGRAMME OF ACTION FOR THE DEVELOPMENT OF AFRICAN REGIONAL STANDARDS FOR ENVIRONMENTAL PROTECTION

A. Programme of Action

Strengthening of Regional Operations of ARSO

130. ARSO's first responsibility in the development of African Regional Standards is to establish the appropriate Technical Committee on Environmental Protection & Pollution Control For effective coordination of such a TC, ARSO would need a strengthened Documentation and Information system network whose main task would be to collect data and retrieve it for use by the TC members in the standards promulgation activities and for the general information of member States of ECA and ARSO.

Development of African Regional Standards (ARS)

131. The priority areas of environmental concern requiring immediate action in Africa are as follows:

(a) Short term activities (Five years)

(i) Environmental sanitation and health and safe drinking water supply

The following regional standards would be needed to provide adequate protection:

(1) test methods for all toxic chemicals and for raw materials used in the treatment of water

(2) drinking water standards

(3) standards for protection of aquatic life

(4) standards for agricultural uses of water

(5) standards for protection of recreational uses of water

(6) industrial water supply standards

(7) effluent standards

(ii) Air pollution

Development of the following types of standards:

(1) ambient air quality standards

(2) emission standards

(3) point of impingement standards

(4) chimney height standards

(5) emergency procedure standards

(6) fuel standards

(7) buffer zone standards

(8) visible emission standards

(9) odour emission standards

(10) flouride in herbages standards

(11) deposited particulate matter standards

(12) workroom air standards.

(iii) Human Settlements

Development of African Regional Standards for low cost building materials including low cost human waste disposal.

(b) Long-term activities (Ten years)

(i) Environmental sanitation and health and safe drinking water supply

(1) development of recommended legislations for :

- atmospheric air pollution prevention control
- water resources and development
- public health and sanitation
- food, drugs and cosmetics
- local authorities health and sanitation bye laws.

(2) Development of guidelines for use of:

- primary health care staff
- public health officers

On hygienic practices for food processing units, meat quality and safety and general public health.

(ii) Air pollution

Compilation of a register of toxic pollutants containing specifications of their short term and long term maximum acceptable limits and their effects to animals, humans, vegetation, etc.

(iii) Human Settlements

(1) Development of building codes and regulations that accommodate low cost housing and upgrade the quality of human settlements; and

(2) Conducting studies aimed at establishing requirements for housing and sanitation for the poor living in slums and squatter settlements in the cities of Africa.

(3) Designing of low cost latrines for human waste disposal in rural areas and in urban slums.

(iv) Desertification and drought

(1) Developing appropriate land-use and conservation plans and guidelines for their implementation taking due cognizance of land use conflicts, systems of taxation, land tenure, water and mineral rights, catchment areas and underground and surface water resources, and their possible enforcement schemes.

(2) Developing guides for land, crop and animal husbandry and their possible enforcement schemes.

Co-ordination of Information on Environmental Monitoring and Protection

132. For ARSO to effectively undertake its standardization activities in the field of environmental protection and pollution control, its information processing capabilities must be strengthened.

(a) Short-term activities (Five years)

(i) Collection of air and water pollution standards, legislations for air and water pollution prevention and in the fields of mining and natural resources preservation, and other documents, including guides, directories, monograms, training manuals, experts reports relating to environmental protection and pollution control issued by member States, regional and international organizations and most importantly UNESCO, ECA, WHO, ILO, UNSO, OAU, UNEP, CODEX, HABITAT, WMO and ISO.

(ii) Compilation and storage of collected information and documentation in a form that can facilitate quick retrieval; for use by TC members and other interested bodies;

(iii) Development of institutional capabilities for an efficient retrieval and fast subject search and environmental standards ordering system to assist ARSO and ECA member States;

(iv) Dissemination of information on request by member States and other interested individuals, regional and international organizations and also through regular publications;

(v) Collection of all the questionnaires that were sent to ECA and ARSO member States on Survey of the existing environment standards in Africa and preparation of report of the detailed analysis of the questionnaires.

Best copy available

(b) Long-term activities (Ten years)

(i) Development of directories for:

(1) Public or Private Laboratories in Africa involved in monitoring and controlling environmental degradation due to air and water pollution.

(2) Public or Private institutions responsible for the development of national standards on air and water pollution.

(3) Experts and personnel involved in the development and implementation of environmental standards and legislations in the monitoring and controlling of air and water pollution.

(4) Experts involved in land, crop and animal husbandry and in the implementation of legislations aimed at soil conservation, wildlife protection, forestry, and natural resources preservation.

(ii) Development of training manuals for seminars and workshops on the various aspects of environmental protection and pollution control in conjunction with UNESCO.

(iii) Establishment of a Regional Centre for environmental research and training with technical assistance from UNEP, WMO, UNSO, ECA, FAO whose responsibility would be to conduct research on various environmental aspects affecting Africa and to develop training materials for use at regional and/or national levels for the promotion of environmental consciousness.

(iv) Development of recommended land conservation and resources preservation programmes for the protection of the African environment and natural resources.

(v) Stimulating the establishment of National Committees on the Environment in each member State of ECA and ARSO along the lines of the Kenya and Malawi experience.

Strengthening of National Institutions involved in Environmental Protection and Pollution Control

Development of National Environmental Standards

133. In the development of National Standards on environmental protection and pollution control, ARSO will be expected to provide regional environmental standards including relevant information and documentation on environmental issues involved. To this end,

ARSO would need technical assistance in order to enable it to undertake specific tasks to provide assistance to member States in establishing and strengthening their National Standards Bodies in environmental protection and pollution control capabilities.

(a) Short term activities (Five years)

134. Provision of assistance should be made to member States in the development of their national machineries for environmental standards formulation, quality control, meterology, inspection, testing documentation and information activities by:

(i) Provision of logistic support and consultancy services. These activities would need technical assistance to ARSO from relevant government and/or donor agencies

(ii) Conducting studies and surveys at national level with the view to establishing, in detail, the peculiar environmental conditions and to determine the amendments that may be required to facilitate adoption of regional environmental standards.

(iii) Promotion of environmental consciousness through:

(1) operation of the ARSO-DIS network;

(2) provision of African Regional Standards on environmental protection and pollution control and other related documentation;

(3) organization of training workshops and seminars on environmental protection and pollution control;

(4) arrangements of fellowship programmes, study tours, visits, etc., and

(5) exchange of information and experts among member States of ECA and ARSO.

(b) Long term activities (Ten years)

135. ARSO would initially provide assistance to and strengthen national standards below of member States of ARSO and later of ECA member States through:

(i) missions to ECA member States which are not members of ARSO in order to:

(1) promote standardization activities in these countries and ensure that environmental protection and pollution activities can be initiated at national level; and

(2) disseminate standardization information on environmental protection and pollution control activities of ARSO and its member States.

(ii) Technical visits to the ARSO headquarters by ECA member States which are not members of ARSO with a view to:

(1) holding discussions on the role of standardization in the socio-economic development of their countries and solicit their support by joining ARSO as members; and

(2) establishing working relations with officials from these countries which will facilitate their support of ARSO activities.

Establishment of Monitoring Infrastructure at the National Level

136. It has been observed that the monitoring and controlling activities on environmental protection and pollution control are in the hands of central governments and local authorities. It is expected that the identified institutions would collaborate with ARSO through national standards bodies in developing appropriate infrastructure for the proper monitoring and controlling of environmental pollution and degradation.

137. It is necessary that all institutions involved with environmental protection and pollution control are identified and an evaluation made of their activities. Such information would assist in determining the approach to be made for the establishment of monitoring infrastructure. The decision-making process involved in this activity is as explained below and shown in Fig. III.

(i) Identifying the institutional strengths and weakness as regards manpower, legislations and their accessory regulations, level of support from the political governments, etc.

(ii) Establish the main areas which need strengthening and develop options for action;

(iii) Specify the costs and benefits involved for each option in terms of resource requirements, negative impacts, etc.,

(iv) Evaluate the costs and benefits of each option in monetary terms if possible, otherwise tabulate them in physical terms.

(v) Compare the costs and benefits of each option and decide.

(a) Short term activities (Five years)

(i) Seeking technical assistance from interested governments and donor agencies for short-term consultancies on the development of the monitoring and control infrastructures; and

(ii) Promoting the adoption of national environmental standards as regulations for use in the monitoring and control of air and water pollution.

(b) Long term activities (Ten years)

(i) Participation in the environmental development activities of ARSO;

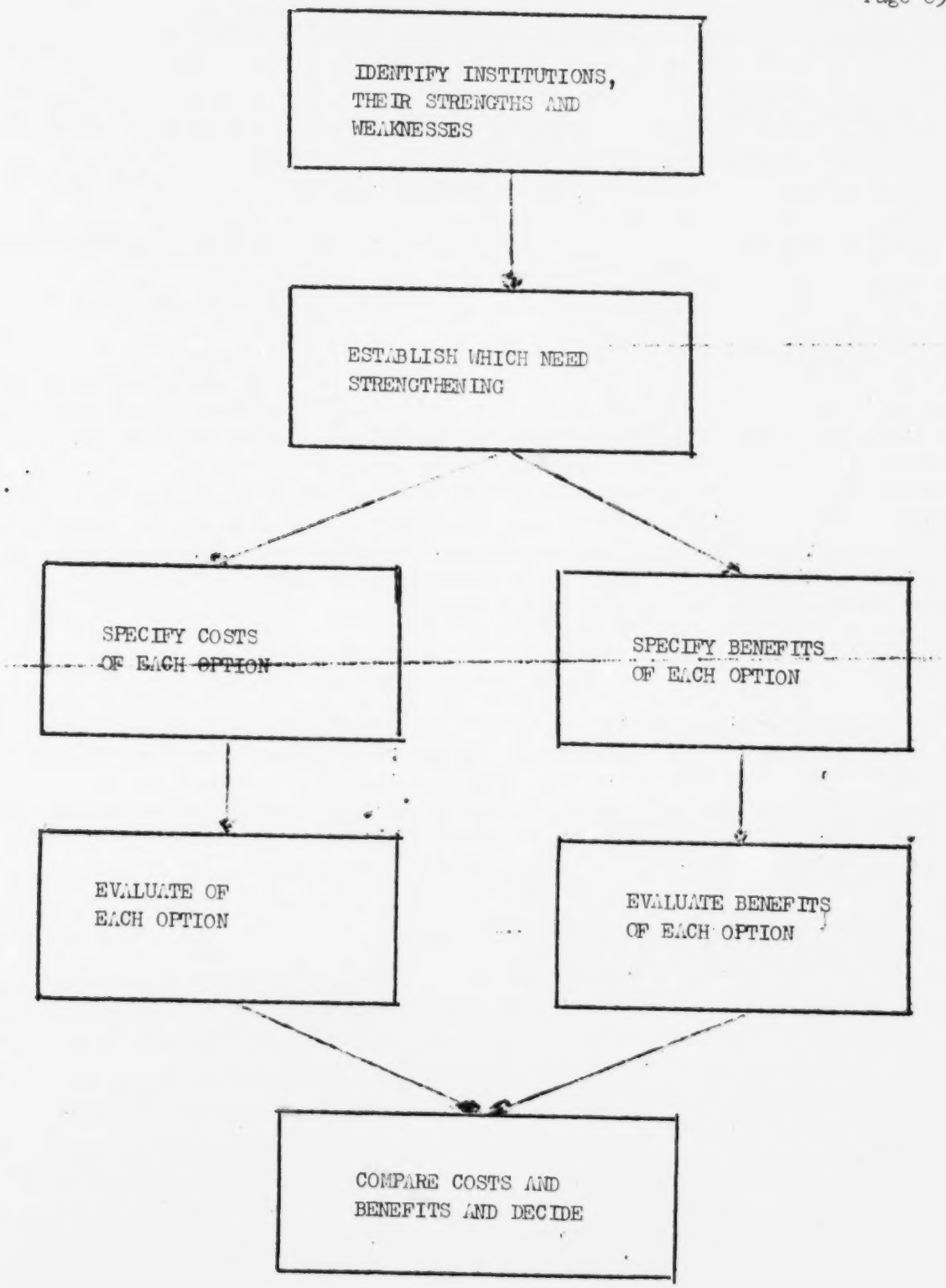
IDENTIFY INSTITUTIONS, THEIR STRENGTHS AND WEAKNESSES
ESTABLISH WHICH NEED STRENGTHENING
SPECIFY COSTS OF EACH OPTION
SPECIFY BENEFITS OF EACH OPTION
EVALUATE OF EACH OPTION
EVALUATE BENEFITS OF EACH OPTION
COMPARE COSTS AND BENEFITS AND DECIDE

Fig. III DECISION MAKING PROCESS

(ii) Participation or recommending any national institution to participate at the training workshops and seminars organized by ARSO alone or jointly with other interested governments and/or regional or international agencies.

(iii) Coordinating, directly or through National Committees for the Environment, the implementation of recommended land conservation and resources preservation programmes for the protection of the African environment and natural resources.

Role of National Standards Bodies

138. During the life of the ECA/ARSO joint project, the national standards bodies will act as national coordinating bodies for standardization activities and involve all the other interested institutions such as the meterological services departments, the sewage works organizations, the health departments, the water supply organizations, etc. in the formulation of water and air quality standards and guides on ecological degradation prevention. The national standards bodies will promote the adoption of regional standards on the environment at national level. In this connexion, the national standards bodies will be linked through their information services units or libraries to the ARSO-DIS Network centre in the ARSO secretariat.

B. Joint ECA/ARSO Programme of Activities for Technical Assistance to member States

139. It is the long-term objective of the ECA/ARSO joint project to assist African governments to develop national standardization for the protection of their environments during the overall economic development. It is expected that the assistance to member States will be made through projects identified by consultants under the Joint ECA/ARSO Project. The following are some of the activities which should be undertaken by the Joint ECA/ARSO Programme (see Table XXII).

(a) Short term activities (Five years)

(i) Collection of information:

This activity is very important as it is from the information collected that a clear picture of the needs of African countries may be determined in terms of:

(1) manpower development and development of institutional capabilities;

(2) technical assistance in the form of laboratory equipment and identification of projects through short-term consultancy for further technical assistance. This activity can have a duration less than one year.

(ii) Development of training materials and manuals for use in training seminars and workshops. This activity can be undertaken with technical assistance from UNEP, UNESCO, FAO, WHO, UNSO and ILO,

etc. depending on the technical content of the training materials. This activity can have a duration of three years.

(iii) Preparation of report on the Survey on the existing standards in Africa arising from the information obtained through the questionnaires sent and not returned in time for inclusion in the present mission report.

(iv) Organization of training seminars on environmental protection and pollution control with the view of sensitizing the member States on the importance of and urgent need for protecting the African environment. This activity will require two seminars, one for the Anglophone and the other for the Francophone countries. These can be organized within a period of four years including one year for planning and acquisition of financial assistance from interested governments and international organization such as ISO, UNEP, UNESCO, FAO, WMO, UNIDO, UNSO, etc.

(v) Development of Directories on:

(1) Experts in the fields of environmental standards development; quality control, inspection and testing, training, etc.,

(2) Experts in the fields of forestry, desertification, agriculture (crop, land and animal husbandry), water resources and development (water engineers, hydrologists, water chemists, etc.)

(3) Experts in the fields of meteorology and climatology, drought, etc.

(4) Private and public laboratories engaged in monitoring and controlling air and water pollution.

(5) Institutions engaged in

- development and implementation of national standards;
- collecting meteorological and agrometeorological data for the purposes of weather forecasting and forecasting weather conditions that precede droughts;
- piped water supply to urban settlements and rural communities;
- health and sanitation activities to all including slums and squatter settlements (institutions such as cities, government departments, etc.); and
- Soil conservation, wild life protection, forestry, natural resources preservation, etc.

This activity can be carried out over a period of five years with technical assistance from interested governments and international agencies such as UNEP, ILO, UNIDO, WMO, WHO, FAO, UNSO, UNESCO, etc.

Table: XXII: ECA/ARSO Joint Project Proposals

ACTIVITY	POSSIBLE SOURCE OF AID	SHORT TERM (YEARS)				LONG TERM					
		1	2	3	4	5	6	7	8	9	10
1. Collection of information	UNEP, etc.										
2. Development of Training materials	UNEP, UNESCO, FAO										
3. Organization of training Seminars	UNEP, UNESCO, FAO										
4. Development of Directories	UNEP, UNESCO, FAO, WHO, UNSO, WMO, UNIDO, ILO, etc.										
5. Establishment of National Committees for Environment	UNEP, etc.										
6. Development of land conservation and resource preservation programmes	UNEP, UNESCO, FAO WHO, UNSO, WMO, UNIDO, ILO, etc.										
7. Establishment of a Regional Centre for Environmental Research and Training	UNEP, UNESCO, FAO, WHO UNSO, WMO, ILO, UNIDO, etc.										

(vi) Stimulating the need for and establishment of National Committees for the Environment in all member States of ECA and ARSO. This can be done over a period of three years through technical assistance for UNEP and other international agencies.

(b) Long term activities

(i) Development of land conservation and resource preservation programmes and other programmes to combat natural disasters including droughts and desertification in Africa through technical assistance from interested governments and international agencies such as UNEP, ILO, WHO, WMO, UNSO, UNESCO, FAO, etc. This activity can take a period of up to ten years.

(ii) Establishment of a Regional Centre for Environmental Research and Training with technical assistance from UNEP, WMO, UNSO, FAO, WHO, UNESCO, ILO, etc., over a period of eight years.

CHAPTER 3

INTERNATIONAL COOPERATION ON ENVIRONMENTAL STANDARDIZATION IN AFRICA

A. Activities of relevant regional and international organizations

140. There are many regional and international organizations in Africa and outside Africa involved with some aspects of environmental measurement, control and protection. Below is a list of regional and international organization operating in Africa cooperating with OAU, ECA and governments of member States in the protection of the African environment.

a) ARSO (African Regional Organization for Standardization)

141. This is an inter-governmental organization responsible for standardization activities in the Africa region. Its purpose is to establish African regional standards for adoption as national standards by member States or for use in the development of national standards. ARSO also aims at providing assistance to member States in the development of their national machineries for standards formulation, quality control, certification marking, meterology, inspection, testing, documentation and information activities by:

(i) providing logistic support and consultancy services;

(ii) conducting studies and surveys;

(iii) promoting knowledge of the various subject matters;

(iv) facilitating the exchange of information and experts among member States; and

(v) arranging fellowships programmes, study visits, etc.

142. ARSO has established a Technical Committee for Environmental Protection and Pollution Control (ARSO/TC9). The scope of the ARSO/TC9 is to undertake standardization activities in the field of environmental protection, sanitation and pollution control. The secretariat is held by Tunisia and Senegal will be the Chairman.

b) The Economic Commission for Africa (ECA/ARSO Joint Project)

143. The ECA jointly with ARSO is launching a project to assist African governments to develop national standards for the protection of the environment in Africa. To do this the project will establish African regional standards for the protection of the African environment and strengthen national institutions, legislative measures and administrative machinery for the monitoring and control of environmental degradation in Africa.

c) The Organization of African Unity (OAU)

144. The OAU in the Lagos Plan of Action made some recommendations on environment and development to indicate its commitment to both protection of the African environment and economic development of Africa. The main recommendations to promote environmentally sound socio-economic development in the Plan of Action for Africa in the context of the

Monrovia strategy for the 1980-1990 development decade are summarized below:

(i) African governments must identify priority areas of environmental concern within their countries for concerted effort to combat environmental problems;

(ii) The Plan of Action at the national level should incorporate the development of policies, strategies, institutions and programmes for the protection of the environment; and

(iii) Regional cooperation in tackling environmental problems with transboundary effects is recommended and member States must also seek international support, advice, and financial resources to implement action on environmental assessment and management.

d) GEMS (the Global Environmental Monitoring System) of UNEP

145. GEMS, a global air monitoring project is now active in some 55 countries. In addition to assembling and analysing air quality data from cities around the world, GEMS provides collaboration in establishing or improving air monitoring facilities, particularly in the developing world. The purpose of GEMS is to keep track of environmental trends, to be able to predict events and to provide decision-makers with sound information upon which to base environment action plans. GEMS principle activity is monitoring - keeping track of - the global environment, but assessment is a primary concern. GEMS collaborates with MARC (Monitoring and Assessment Research Centre attached to London University) whose research programme is specifically concerned with the development of monitoring and assessment techniques appropriate to environmental problems. It also liaises with the WHO collaborating Centre on Environmental Pollution Control, and the United States Environmental Protection Agency.

146. The main objectives of GEMS are the following:

(i) to detect significant changes in the environment;

(ii) to study levels and trends of environmental indicators for the purposes of deciding upon and planning corrective action;

(iii) to check on compliance with established environmental quality criteria and standards;

(iv) to check on the efficiency of control systems and corrective measures;

(v) to survey and study the effects of environmental changes, in particular on main health and food supply and on natural resources;

(vi) to study the effects of specific human activities on the environment, so as to determine whether alternative patterns of activity would be more appropriate;

(vii) to collect time series of data on a number of variables in order to identify cause-effect relationships between them;

147. The current activities of GEMS are divided into five major programmes:

(1) renewable natural resource monitoring;

(2) climate-related monitoring

(3) health-related monitoring

(4) monitoring of the long-range transport of pollutants; and

(5) ocean monitoring.

e) United Nations Centre for Human Settlements (UNCHS) - (HABITAT)

148. The UNCHS (HABITAT) is the body within the UN system entrusted with the central responsibility for human settlements. It co-operates with UNEP to deal with the aspects of human settlements. It has three main activities:

(i) Providing technical assistance to UNDP funded projects and co-ordinating human settlements in the UN system;

(ii) Conducting research and development activities on settlements policies, planning and strategies; building infrastructure technology, and shelter and community services; and

(iii) developing audio-visual materials, providing information on the results of the studies and organizing training jointly with sponsoring agencies and governments on many aspects for planners and decision makers.

In the HABITAT Work Programme for the biennium 1984-1985, a training programme was planned for training governmental officials and planners to promote the application of environmental guidelines for human settlements planning in selected countries.

f) United Nations Sudano-Sahelian Office (UNSO)

149. UNSO's central responsibility is to assist member States in their drought-related programmes of recovering, rehabilitation and development. These programmes include all-weather feeder roads, seed multiplication, etc. Additional projects related to combating desertification include afforestation including fuelwood plantations; village woodlots and greenbelts, water for irrigation, alternative sources of energy, institutional support, research, training, planning, coordination, etc. UNSO-supported projects are executed by the governments of the region themselves and by the relevant agencies of the United Nations System.

g) United Nations Educational, Scientific and Cultural Organization (UNESCO)

150. UNESCO is a body within the UN system entrusted with the responsibility on educational, scientific and cultural activities. As such, UNESCO has participated in several programmes separately and jointly with other agencies on issues related to

environmental education, etc., for example:

a) Publication on the Activities of the UNESCO-UNEP International Environmental Education Programme (1975-1983);

b) Publication on Glossary of Environmental Terms;

c) Educational module on Environmental Problems in cities (Publication);

d) Module for in-service Environmental Education training of primary school teachers and supervisors (Publication);

e) Module for in-service Environmental Education training of science teachers and supervisors for secondary schools (Publication);

f) Module for in-service Environmental Education training of social studies teachers and supervisors for secondary schools (Publication);

g) The inter-disciplinary approach in environmental education: A guide for curriculum developers (Publication); and

h) European seminar on the role of the university in environmental education (1983) Budapest.

151. UNESCO's activities on drought and desertification in Africa are covered by the following activities under the Major Programme "The Environment and Terrestrial and Marine Resources" which deals with:

(i) Rational use and conservation of water resources in Africa south of the Sahara

(ii) International Hydrological Programme (IHP); and

(iii) The MAB (Man and Biosphere) Programme activities concerning the Integrated Projects on Arid Lands (IPAL) in northern Kenya and Tunisia.

h) World Health Organization (WHO)

152. The WHO is a body in the UN system whose central responsibility is public health. The WHO initiated an air quality monitoring cooperative project in 1973 in which member States contribute data from a number of urban air monitoring stations. These are either existing stations which belong to a national or local network or stations which have been set up with resources made available under the project. The air quality monitoring project provides an input to GEMS, a project of the UNEP. WHO, in cooperation with GEMS of UNEP and a team of experts from universities and various national departments of health and the environment, developed a second air monitoring project, as a result of which a number of pilot projects on exposure monitoring are being implemented in different parts of the world.

153. The International Programme on Chemical Safety (IPCS) was established in 1980 as a collaborative programme between UNEP, ILO and WHO with a unit at WHO Headquarters in Geneva. IPCS was established as a direct response to a recommendation at the World

Health Assembly in May 1977, where the member States considered that the growing use of chemicals in public health, industry, agriculture, food production and in the home, need recognition in the health policies and strategies of all countries (Health for all by the year 2000). The principle objectives of the programme are to:

(a) carry out evaluation of the risk to human health and the environment from exposure to chemicals, and disseminate the information to member countries;

(b) encourage the continuous improvement of laboratory and epidemiological methods in health and environmental risk evaluations;

(c) promote technical co-operation among member countries as regards the assessment and control of environmental and health hazards that may arise from production, use and disposal of chemicals with particular reference to developing countries;

(d) promote effective international co-operation with respect to emergencies and accidents involving chemicals;

(e) promote training of manpower needed for testing and evaluating the health and environmental effects of chemicals and for the use of regulatory and other control activities.

i) International Labour Organization (ILO)

154. The ILO is a body in the UN system entrusted with the responsibility of human occupation. ILO is also interested in health risks to which workers are exposed within their working environment. In this connexion, ILO has prepared a document on Occupational Exposure Limits for Airborne Toxic Substance which was updated in 1983 jointly with the International Register of Potentially Toxic Chemicals (IRPTC), which is a UNEP programme.

j) Food and Agriculture Organization (FAO)

155. The FAO is a body in the UN system entrusted with the responsibility of promoting food production and food security. The FAO is engaged in projects on:

(i) the improvement in rainfed agriculture, soil conservation and combating desertification;

(ii) the integration of livestock with crop production;

(iii) improving forestry development;

(iv) strengthening of science and technology, involving people in development programmes for land reforms.

A joint FAO/UNEP survey of the application of biological nitrogen fixation for enhancing soil fertility and increasing legume production in small farms in a number of developing countries in Africa, Asia and Latin America was completed in 1983 with the support of regional MIRCENS (Microbiological Research Centres).

k) World Meterological Organization (WMO)

156. The aim of the WMO, through its air monitoring programme, is to determine current levels of atmospheric pollution and, more importantly, to identify long-term trends in the concentration of significant constituents which may affect the environment sufficient to induce climatic changes. The WMO aims at promoting improvements in weather forecasts and the standardization and dissemination of weather observations taken over the entire globe in 157 member nations. It contributes to the prevention of climate-related natural disasters through a number of activities. Its global Tropical Cyclone Programme aims at strengthening the capabilities of member States to detect, tract, and forecast the approach of tropical cyclones and to organise and execute the essential disaster prevention and preparedness measures. It has three objectives on meterological droughts:-

(i) to make better use of existing climatic data and information, with emphasis on applications in food, water and energy;

(ii) to improve understanding of climate processes through research; and

(iii) to detect and warn governments of significant climatic events, both natural and man-made, which can greatly affect human activities.

157. WMO has stations in the WMO Background Air Pollution Monitoring Network (BAPMoN). Stations operating under BAPMoN obtain data and send them to WMO for appropriate action. BAPMoN stations operate according to several resolutions of the WMO Executive Committee. The WMO network includes the following three categories of stations:

(i) Baseline Air Pollution Stations: These stations are located in areas where no significant changes in land use are anticipated for at least 50 years within several hundred km in all directions from each station and carry out a rather sophisticated programme;

(ii) Regional Air Pollution stations perform a simple observation programme. The siting of these stations follows in principle the same requirements as needed for baseline stations but is less critical than that of the baseline stations. Regional stations should be located away from major urban centres. An additional criterion is that the stations be expected to have sufficient longevity so as to provide representative trends in regional values of aerosols' optical depth and precipitation chemistry; and

(iii) Regional Stations with Extended Programmes: These regional stations carry out more than the minimum programme. In addition to meeting or exceeding the criteria for a regional station, they should be located in a remote area (preferably mountainous) and not be influenced by any pollution sources within a 100 km radius.

l) Joint FAO/WHO Food Standards Programme - Codex Alimentarius Commission

158. The Codex Alimentarius Commission was established to implement the Joint FAO/WHO Food Standards Programme. The purpose of the programme is:

(i) to protect the health of consumers and to ensure fair practices in the food trade;

(ii) to promote coordination of all food standards work undertaken by international governmental and non-governmental organizations;

(iii) to determine priorities and initiate and guide the preparation of draft standards through and with the aid of appropriate organizations; and

(iv) to finalize standards, and after acceptance by governments, publish them in a Codex Alimentarius either as a regional or worldwide standards.

The Codex Alimentarius Commission established the FAO/WHO Coordinating Committee for Africa to which membership is open to all member Nations and associate Members of FAO and/or WHO within the geographic location of Africa. The Coordinating Committee for Africa exercises general coordination in the preparation of standards relating to the region of Africa and exercises such other functions as may be entrusted to it by the Codex Alimentarius Commission.

m) International Organization for Standardization (ISO)

159. The ISO is a specialized international agency for standardization. The object of ISO is:

(i) to promote the development of standards in the world with a view to facilitating international exchange of goods and services; and

(ii) to developing mutual cooperation in the sphere of intellectual, scientific, technological and economic activity.

160. The scope of ISO covers standardization in all fields except electrical and electronic engineering standards which are the responsibility of the International Electrotechnical Commission. Amongst the many technical committees of ISO are the ones given below which deal with some aspects of environmental monitoring and control:

(i) ISO/TC 24 Agricultural food Products;
(ii) ISO/TC 94 Personal Safety - Protective clothing and Equipment;
(iii) ISO/TC 146 Air Quality;
(iv) ISO/TC 147 Water Quality; and
(v) ISO/TC 158 Analysis of Gases.

n) International Electrotechnical Commission (IEC)

161. The IEC is the organization responsible for international standardization in the electrical and electronics fields. The IEC works in close cooperation with ISO and maintains working relationships with about 200 international bodies, both governmental and non-governmental, interested in international standardization. Some of the IEC technical committees are responsible for developing standards for a defined sector of technology dealing with basic environmental testing.

o) United Nations Industrial Development Organization (UNIDO)

162. UNIDO is responsible for industrial development activities in several basic industries such as agro-based, mining and metallurgy, construction, forest-based, chemical, engineering and small-scale or cottage industries. In promoting rapid industrialization in Africa during the UN Industrial Development Decade for Africa, UNIDO is concerned also with the safe disposal of industrial solid wastes and effluents into rivers.

p) International Atomic Energy Agency (IAEA)

163. IAEA has the responsibility to monitor globally the use and development of radio-active materials for peaceful purposes such as the construction of atomic power stations for generating electricity, as well as in the destructive use of atomic power in making bombs. IAEA also regulates the safe disposal of radio-active waste material to prevent pollution of the soil, air, water, as well as hazards to health.

q) United Nations Development Programme (UNDP)

164. The role of the UNDP in promoting the development of national standards for the protection of the environment is seen through the financial support it gives to ARSO directly, and indirectly, through the country programmes financed by UNDP for arresting environmental degradation through combating drought and desertification, soil erosion and so on.

r) Permanent Inter-state Committee for Drought Control in the Sahel (CILSS)

165. CILSS comprises of eight African countries (Cape Verde, the Gambia, Burkina Faso, Mali, Mauritania, Niger, Senegal and Chad), with a Headquarter located in Ouagadougou (Burkina Faso), has the following objectives:

- to co-ordinate the main activities for drought control;
- to sensitize the international community on drought problems;
- to mobilize resources necessary for the implementation of the programmes by the CILSS member States for drought control and Sahelian development;

- to mobilize resources necessary for the reinforcement of sub-regional co-operation within member countries;
- to implement a "Regional Plan for Combating Desertification".

The CILSS countries and the OECD donor countries created jointly the Club of Sahel, the objectives of which are to assist technically and financially the Sahelian countries in implementing the above-mentioned activities. Also CILSS member States have established the Institut du Sahel which is responsible for research and training for desertification control. The Institut du Sahel is a specialized agency of CILSS coordinating scientific and technological research for a recovery and rehabilitation programme for the Sahel. It also provides training courses on desertification control for scientists, technicians and field extension workers in the Sahel.

B. Inputs and Assistance from donor Governments and Agencies

166. As described in Chapter 2 above, the successful implementation of the Programme of Action for the development of African Regional Standards for environmental protection in general and the strengthening of operations of ARSO and the operations of the Joint ECA/ARSO Programme of Activities for Technical Assistance to member States in particular, technical assistance from governments and international agencies is of vital importance. During its life, the ECA/ARSO Joint Project is expected to:

(a) provide support and consultancy services;

(b) conduct studies and surveys;

(c) promote knowledge of the various aspects of environmental protection and pollution control;

(d) facilitate the exchange of environmental information and experts among member States; and

(e) arrange fellowships programmes, study visits, etc.

To this end donor governments and international agencies would be required to come in full force to support the programme elements within the Joint Project which fall within their spheres of interest. ARSO hopes that the financial support which it receives from the UNDP, UNIDO and from France and from the Federal Republic of Germany as donor governments will continue to promote the effective development of standardization activities in Africa.

CHAPTER 4

RECOMMENDATIONS AND GUIDELINES FOR STRENGTHENING NATIONAL INFRASTRUCTURE FOR THE ASSESSMENT AND MANAGEMENT OF ENVIRONMENTAL DEGRADATION IN AFRICA

A. Summary of Findings for the Development of National Environmental Standards

167. The summary of findings for the development of national environmental standards can be divided into five main topics:

(a) General information
(b) Air pollution and weather forecasting
(c) Water pollution and sanitation
(d) Ecological degradation
(e) Maintenance of environmental standards

(a) General information

(i) Ethiopia is basically an agricultural country undergoing one of the most devastating effects of drought. It is in the Sudano-Sahelian belt affected by drought and desertification;

(ii) Egypt is geographically a desert with all its population living along the Nile Valley and oases. Its economy is based on minerals and petroleum resources;

(iii) Zimbabwe has an abundant supply of mineral resources (except oil) and a well developed commercial, agricultural and industrial sectors;

(iv) Malawi is an agricultural country with no exploitable mineral resources. It is among the densely pollutated countries in Africa.

(b) Air Pollution and Weather Forecasting

(i) Most meteorological services in the countries visited were established initially for the purpose of civil aviation weather forecasting;

(ii) Egypt has serious air pollution problems from desert dust, vehicle emissions, domestic cooking and industrial emissions. The cities are prone to temperature inversion and resultant acute health hazards;

(iii) The Meteorological Authority in Egypt is involved in:

1. Weather forecasting for civil aviation
2. UNEP/WMO Background Air Pollution Monitoring Network (BAPMoN) and has three stations:

- Sidi Barrani - near Mediterranean sea
- Oasis Swai - in Western desert
- Hargada - along Red Sea Coast

3. has laboratories of its own for controlling air pollution;
4. does conduct air pollution monitoring and is interested with motor vehicle emissions as well as with air pollution;
5. there are no air pollution standards, but regulations exist in this respect.

(iv) The National Meteorological Services Agency of Ethiopia is engaged in agrometeorological and climatological data collection. It is involved in UNEP/WMO BAPMoN and has a station at Baherda. It is not involved in air pollution standards;

(v) The Air Pollution Control Unit in Zimbabwe is attached to the Ministry of Health and has well established legislative infrasturcture for the monitoring and control of air pollution. Jointly with the Meteorological services Department, the Unit established a network of gas detectors to monitor the patterns of pollution in specific areas and human settlements;

(vi) The Meteorological Services Department in Zimbabwe is involved in obtaining agrometeorological and climatological and climatological data. It is proposed by WMO to be a subregional centre for SADCC countries. It has no laboratories of its own for monitoring air pollution.

(vii) The Department of Meteorological Services in Malawi is involved in climatological and agrometeorological data collection. It has no laboratories of its own for monitoring air pollution.

(c) Water Pollution and Sanitation

(i) Human suffering in Africa today is partly due to poor sanitation and persistence of water-borne and environment-related diseases;

(ii) Nile River would have been one of the most polluted rivers in Africa with over 45 million people living along its banks in Egypt alone, had Egypt not established pollution control research facilities to solve the country's pollution problems;

(iii) The National Research Centre in Egypt conducts water pollution research on topics such as:

- waste water treatment;
- bacteriological studies;
- heavy metals monitoring;
- pesticide residues; and;
- oil pollution.

(iv) The Water Supply Organization in Cairo provides water to 12 million people treated in accordance with Egyptian standards and the Environmental Health Department regulations. The major problems are:

- Algal growth;
- Traces of ammonia and nitrites; and
- lack of adequate laboratory equipment.

(v) The Greater Cairo Sewage and Sanitary Drainage Organization undertakes sewage treatment and solid waste disposal. The problems encountered are:

1. production of hydrogen sulphide in sewer pipe presents corrosion problems,
2. rehabilitation of corroded sewer pipes and tanks;
3. lack of laboratory equipment.

(vi) Department of Environmental Health of Egypt has the overall responsibility for coordinating environmental health and sanitation. It has jointly established national standards with the EOS which currently guide the activities of the Water Supply Organization in Cairo and the Greater Cairo Sewage and Sanitary Drainage Organization;

(vii) The Egyptian Organization for Standardization has developed standards on water and food products which are currently used as regulations by the Department of Environmental Health;

(viii) Addis Ababa Water and Sewage Authority has serious problems with safe drinking water supply and solid waste disposal;

(ix) The Environmental Health Department in Ethiopia is engaged in:

- food and beverage control;
- industrial and occupational hygiene;
- housing and solid waste management;
- general sanitation; and
- waste water control and water.

Its main problems are:

1. very old rules and regulations are in operation;
2. delays by government in approving revised regulations;
3. lack of cooperation with other water authorities in water quality control;
4. no clearly defined regulations outlining the responsibilities of individual organizations;
5. 75% of the feacal and water-borne diseases can be prevented;
6. Lack of good sanitation in slums and squatter settlements;
7. no control of industrial effluent pollution;
8. may not meet the "health for all by year 2000" target; and
9. may not achieve the objective of the International Drinking Water Supply and Sanitation Decade (1980-1990).

(x) The Public and Environmental Health Planning Department in Ethiopia ensures planning for water development and its effects on the public health. Fertilizers and pesticides are posing serious environmental problems. Regulations are out-of-date and require review and revision. There is a small laboratory which needs strengthening with additional equipment;

(xi) The Sewage Works of the Department of Works of the Municipality of Harare, Zimbabwe, is responsible for sewage treatment. Effluent containing nutrients caused algal blooms and growth of water hyacinth and nearly killed Lake MacIlwaine which supplies water to Harare and Municipality. Research jointly conducted with the University of Zimbabwe solved the problems and suggested procedures for waste disposal.

(xii) The Ethiopian Standards Institution needs strengthening in food quality control. It will soon receive the Industrial Chemistry Department from the Central Laboratory and Research Centre which will consolidate its water quality control activities;

(xiii) Water Pollution Control Unit in the Ministry of Health of Zimbabwe coordinates the overall water pollution control activities through the Water Act and accessory regulations. This is one of the best water pollution monitoring system in the countries visited. It has stringent effluent standards to protect the rural community;

Factories are expected to pretreat their effluent and discharge only that which complies with effluent regulations.

(xiv) The Sewage and Pollution Control Unit of the City of Blantyre, Malawi is responsible for effluent treatment in Blantyre. Industries are required to pretreat their effluent before discharging into the sewers;

(xv) The Health Department of the City of Blantyre conducts routine inspections of houses, playfields, housing estates, cinema halls, etc. for sanitation standards and safety requirements. The department is responsible for sanitation and health of the city inhabitants. Blantyre is one of the cleanest cities visited;

(xvi) The Blantyre Water Board supplies safe drinking water to all people in Blantyre including those living in slums and squatter settlements. One water kiosk supplies water to 500 people. The standards used are WHO recommendations;

(xvii) The Zomba Sewage Works Unit in Malawi is one of the most efficiently run small sewage plants in the countries visited. It uses conventional sewage treatment process involving biological filters, maturation ponds and digestion of sludge;

(xviii) The City Engineer's Department of the City of Lilongwe in Malawi operates several sewage treatment plants. Due to breakdown it has been forced sometimes to discharge raw sewage into Lilongwe river. Now it plans to use oxidation ponds which are easy to look after and does not require heavy capital outlay;

(xix) The Water Resources Board of Malawi has a small laboratory which conducts water tests. The secretariat is poorly staffed and has the following problems:

1. There are no specific regulations controlling every aspect in water abstration and usage including effluent discharge; and
2. Standards for industrial effluent are not being enforced and/or observed by industry.

(d) Ecological degradation

(i) Timber harvesting and heavy demands for fuelwood in the countries visisted have been the main causes of deforestation, changes in the climatic conditions, and drought. The following measures are being taken to abate further deterioration of the environment:

(1) Reforestation programmes on hillslopes and catchment areas with fast growing exotic plant species;

(2) Enactment of legislation to provide governments with the necessary legal instruments for the conservation of forests and catchment areas and prevention of farming on hillslopes, catchment areas and along river banks;

(3) Promotion of awareness of good land husbandry through extension services and environmental education activities;

(4) Establishment of wood energy programme to supply tree seedlings for the development of village and school woodlots;

(5) Encouraging farmers to keep manageable numbers of livestock to reduce soil degradation through overstocking and overgrazing;

(6) Production of land husbandry manuals for use by extension aid workers and in training programmes.

(ii) Poor agricultural practices has exercabated soil erosion and degradation, deforestation, drought and desertification. Several programmes and activities are under way in many countries which are sponsored by international organizations, donor governments and UN specialized agencies, for example:

(1) The improvement of rainfed agriculture, soil conservations and combating desertification by the FAO;

(2) The integration of livestock with crop production by the FAO;

(3) Strengthening science and technology involving people in development programmes of land reform by the FAO;

(4) Rational use and conservation of water resources in Africa south of the Sahara by the UNESCO;

(5) The MAB (Man and Biosphere) programme activities concerning the Integrated Projects on Arid Lands by the UNESCO; and

(6) Projects related to combating desertification such as afforestation (fuelwood plantations, village woodlots greenbelts), aridlands irrigation and alternative sources of energy by UNSO.

(iii) Uncontrolled burning of bush in order to clear forests for agriculture has destroyed genetic plant resources and caused soil erosion, flood and siltation. Zimbabwe has taken the lead in legislating against bushfires;

(iv) Soil pollution from human excreta, industrial solid waste and agricultural chemicals are a serious threat to terrestrial and aquatic ecosystems. Several countries have developed or are in the process of developing legislations to control the practice of human and industrial waste disposal and the importation, use and disposal of agricultural chemicals.

(e) Establishment and Maintenance of Environmental Standards

Nearly all National Standards Bodies (NSBs) are mandated with the central responsibility for all standardization activities at national level, and such activities include industrial products, food and drugs. Due to national priorities, in practice most national standards bodies are involved in the promulgation of national industrial standards, leaving activities on food and health to the relevant institutions:

(i) The Standards Association of Central Africa (SACA) of Zimbabwe is more inclined to the development of engineering and mining standards. In recent years water analysis has increased due to the difficulties the Government Analyst's Laboratories have been facing in handling an ever increasing number of samples from government and the private sector;

(ii) Malawi Bureau of Standards (MBS) has developed relatively few national standards due to insufficient support in developing standards writing capabilities. However, it has well-developed laboratory capabilities in the pesticide residues analysis. Additional equipment for food quality control and for water analysis would strengthen its activities in these areas;

(iii) The Egyptian Organization for Standardization and Quality Control (EOS) has over 25 years of experience in the field of standardization and has advanced quality control capabilities in the fields of engineering and metrology. Additional equipment is needed to strengthen its activities for food quality control, pesticide residue analysis and water analysis for referral purposes;

(iv) Ethiopian Standards Institution (ESI) has recently moved into a custom-built building constructed with the technical assistance from UNIDO. When all its laboratory equipments are installed and the Industrial Chemistry Department of the Central Laboratory and Research Centre is transferred to the ESI as planned, it will have a reasonable capabilities in the food and water quality control. Strengthening of such capabilities are needed in the form of training and additional specialized equipment.

B. Guidelines for Strengthening National Infrastructure for Assessing and Managing Environmental Degradation in Africa

168. In considering the guidelines for strengthening national infrastructure for assessing and managing environmental degradation in Africa, considerations of the assessment and management infrastructures should be made. Short-term appraisal missions for the evaluation of specific pollution control institutions are required to establish the immediate needs of such institutions for effective assessment of environmental degradation. To this end, the ECA/ARSO Joint Project should seek technical assistance from donor governments and international agencies to undertake this activity. It is from such short-term visits and appraisal missions that studies can be sponsored to develop projects outlining the exact nature of assistance to strengthen the environmental management and assessment capabilities of ECA member States.

Assessment of National Infrastructure

169. It should be realised that without an effective national pollution control infrastructure very little can be achieved from efforts on environmental protection. In this connection, the first step is to obtain information on various aspects of environmental activities at national level. Information or the lack of it from a member State will indicate areas where more action is required by the ECA/ARSO Joint Project. In all instances the action plan for the strengthening of national assessment infrastructures calls for the following steps to be observed:

(a) Establish or designate a government authority to be the national contact point or coordinator of a specific activity e.g. meteorological services, standards development activities, control of desertification, droughts, monitoring and early detection of natural disasters, monitoring and control of environmental pollution, etc.;

(b) Assess the problems prevailing in a country on specific fields and collect adequate data which would assist in decision making on what action to take at country, subregional or continental level;

(c) Assist in the establishment of national priorities for actions. This activity requires assistance from international organizations such as UNSO, UNESCO, FAO, WHO, WMO, ILO, UNEP, UNCHS - Habitat, etc.;

(d) Assist in the selection among national priorities of those actions which could be taken :

- nationally ;
- with the support of regional or international organizations or other foreign sources ;
- in the framework of subregional, regional or international; cooperation; or
- only with foreign aid.

(e) Assist in the preparation and submission of request for international support for specific activities within the above priorities;

(f) Implement action as per project in accordance with national plans, and regional objectives.

170. Institutions engaged in monitoring and control of environmental pollution can be classified into four major categories:

(a) Air Pollution Control Insititutions
(b) Water Pollution Control Institutions
(c) Ecological Degradation Control Institutions
(d) Legislative Institutions.

(a) Air Pollution Control Institutions

(i) Strengthening of Air Pollution Control Institutions is urgently needed in order to control the increasing dangers from air pollution arising from industrial activities, motor vehicles emissions and domestic cooking with fuel wood. Observations have indicated the growing dangers from air pollution following the rapid social and economic development Africa is experiencing;

(ii) Air pollution prevention institutions should be established urgently in countries where they do not exist with the central responsibility of monitoring and controlling air pollution and to stimulate the development of an air pollution prevention legislation and an air pollution monitoring system. Such activity would be preceded by a short-term study by ARSO officials followed by a consultant with financial assistance in both cases from donor governments and/or international agencies;

(iii) There is urgent need to undertake research in alternative forms of energy in order to reduce pressure on forests which are undergoing rapid deforestation from the rural communities harvesting fuelwood for cooking and to keep warm. Wood burning for cooking generates huge quantities of fumes and smoke which present serious health hazards to mothers who spend more time in the kitchen making fires and preparing food;

(iv) The meteorological services department should be strengthened in terms of air pollution monitoring equipment and data processing equipment with the view to extending their operations and expertise from the traditional weather forecasting and background air pollution monitoring on behalf of WMO. Information obtained can play an important role in developing appropriate national standards and African regional standards;

(v) Industries should be required to instal some air pollution abatement equipment in order to reduce the amount of air pollutants emitted. The form of investment can best be made at the stage when an industry is being established. Later investments usually can be expensive and sometimes not appreciated by industry. It is a general requirement by some sewage treatment plants to expect industries to pretreat those effluent considered hard to deal with and most of the times they comply.

(b) Water Pollution Control Institutions

(i) Water pollution is by far the most serious problem in Africa exercabated by:

- incidences of drought;
- increasing slums and squatter settlements in major cities;
- inefficient sewage treatment and constant breakdowns;
- lack of effective legislations and regulations on water pollution prevention;
- insufficiently treated drinking water supply;
- large-scale agricultural production;
- inability to take adequate environmental measures at the planning stages of developmental programmes, etc.

(ii) Water-borne diseases and other environment-related diseases are known to be responsible for nearly 80% of all diseases affecting people in Africa and most of the diseases can be prevented through good sanitation and water pollution prevention measures;

(iii) It is recommended that effective water pollution legislations be developed urgently for adoption by member States in order to assist them with the water quality and pollution control activities. Further technical assistances should be provided to those countries found to be in need of a comprehensive water quality monitoring scheme. The operation of a water quality monitoring scheme requires the use of regulations in the form of national standards for methods of tests and the adoption of national standards as regulations to set limits for various toxic chemicals and other water pollutants;

(iv) Public and private laboratories should be strengthened in order to provide the necessary testing infrastructure which forms the backbone of a monitoring system. It has been found that most laboratories are far from adequate. Some even lack basic facilities while others, because of lack of aftersales services and spare parts, have some sophisticated equipment inoperational;

(v) Sewage treatment plants and water supply organizations should be provided with laboratory equipment in order to facilitate in-house quality control. Some major cities have been found unable to provide safe drinking water due to many factors of which some are the lack of testing equipment and adequate capital to rehabilitate contaminated water pipe system.

(c) Ecological Degradation Control Institutions

(i) It has been observed that institutions in this category are generally government departments / sections, research institutions, etc. entrusted with the central responsibility to implement the provisions of their respective legislations. To determine the form of assistance short-term studies should be made.

(ii) It is recommended that information on available legislations and technical materials should be obtained from member States with the view to developing manuals on crop, land and animal husbandry, soil conservation programmes, etc. which would assist member States in the proper management of their natural resources;

(iii) The meteorological and hydrological services departments should be strengthened in order to enable these institutions to collect data which would enable decision makers to take timely actions in respect of drought, and other natural disasters.

(d) Legislative Institutions

It is recommended that technical assistance be obtained for short-term studies leading to recommendations that would assist member States to formulate recommended legislations in the following fields:

1. Air pollution prevention and recommended regulations;
2. Water pollution prevention, water resources or water with recommended regulations;
3. Other relevant legislations to control exploitation of natural resources, conservation of soils, catchment areas and forests; etc. and for combating deforestation, desertification and drought.

Managing Environmental Degradation

171. Management of environmental degradation is the responsibility of government authorities mandated by legislation to do so. In order to enforce any legislation, regulations are almost always used which employ standards in the form of guidelines, codes test methods, limits or specifications. In considering these recommendations and guidelines it is important to note that national standards bodies are entrusted with the central responsibility of developing national standards for use by interested authorities at national level or for adoption as regulations for mandatory enforcement. In the case of environmental degradation, nothing short of mandatory enforcement will yield the expected solutions.

172. The ECA/ARSO Joint Project should coordinate all continental activities on the identification and contracting of short-term consultancies for appreciation of national problems, prefeasibility and feasibility studies leading to:

- development of capital investment programmes and projects;
- pilot and demonstration projects;
- training programmes; and
- development of research programmes.

173. In order to provide adequate attention to the institutional infrastructures for managing environmental degradation it has been found necessary to divide the subject into the following headings:

(a) Water pollution and safe drinking water;
(b) Air pollution and weather forecasting;
(c) Soil degradation, deforestation, drought and desertification;
(d) Environmental sanitation and health.

(e) Human settlements;
(f) Mining;
(g) Environmental Education, training, and information.

(a) Water pollution and safe drinking water

(i) Water quality standards should be developed as a matter of urgency following the topics indicated in Annex III.
Since there are still a few ECA member States which do not have national standardizing bodies, urgent steps should be taken, under the ECA/ARSO Joint Project with the assistance of ISO, UNIDO and other international organizations, to establish national standards bodies. Those already in existence should be strengthened in order to act effectively as national focal points and coordination institutions for the Joint Project. In developing water quality standards it is important that these standards are divided into the following headings depending on the intended use namely:

1. Drinking water standards: These standards could be based on the WHO International Standards for Drinking Water. If all countries in Africa develop these standards, the quality of life would be improved for many urban settlements which account for a reasonable proportion of the population of Africa. Many African countries are engaged in rural piped water projects and the use of water standards would upgrade the quality of life in rural communities and reduce the incidences of water-borne and environment-related diseases.

2. Standards for the protection of aquatic life: These standards are related to effluent standards. The development of air emissions and liquid effluent standards should provide adequate protection.

3. Standards for agricultural uses of water: Agriculture is the mainstay of many African countries and use of pollution free water would

   - ensure productivity from the soil by reducing salination; and
   - protect livestock from the toxic effects of some chemicals which may affect their behaviour, reproduction or physiology.

4. Standards of protection for recreational uses: These standards are necessary to preserve the aesthetic appeal of recreational waters used for swimming, boating, fishing, etc.

5. Industrial water supply standards: Water quality requirements differ for various industrial processes even within a single plant. However, modern water treatment technology is capable of treating almost any raw water to render it suitable for any industrial use. The ECA/ARSO Joint Project should investigate the feasibility of strengthening water supply organizations in ECA member States with assistance from FAO, WHO, World Bank, etc.

(ii) Effluent Standards

It is recommended that regional standards be developed for eventual adoption by national standards bodies on effluent and should be graded in such a way that the one end of the grading system represents the

minimum requirements for effluent discharged into a large water body with good assimilative capacity and the other end of the grading system represent the minimum requirements for effluent discharged into small water bodies without good assimilative capacity. This approach would allow industries to treat their effluent accordingly and avoid over-protection or underprotection which arises from the use of uniform effluent standards;

(iii) It is recommended that transboundary treaties and conventions be concluded in the control of pollution of rivers, lakes, and seas which are shared by several countries. This would prevent water pollution practices in one country from affecting another while at the same time promote collective approach in solving common problems.

(b) Air pollution and weather forecasting

(i) Air quality standards are extremely important since it is known that some pollutants can travel and affect the environment thousands of kilometers away from the source of emission. In this connection, it is recommended that:

1. Air pollution monitoring stations should be established initially in all major commercial and industrial cities in Africa to monitor air pollutants from factories, motor vehicles and other institutions which use fuelwood, coal or oil to generate steam or electricity.

2. Care should be taken when considering the establishment of pollutive industries such as tanneries, cement factories, oil refineries, meat processing factores that pollution abatement measures including pre-treatment of emissions are considered at the planning stages.

3. Transboundary treaties and conventions should be concluded among neighbouring countries which would provide a forum for resolving any common air pollution problems.

(ii) It is recommended that the meteorological services in ECA member States be upgraded in status, entrusted with the additional responibility for monitoring air pollution, and be strengthened with adequate equipment in order to carry out these duties;

(iii) It is recommended that ARSO should immediately develop air pollution standards which will form the basis for developing national air pollution standards. In performing this activity ARSO should develop the following types of air quality standards:

1. Ambient air quality standards. These standards place limits on levels of air pollutants in the ambient air during a given period of time to meet acceptable levels of air quality. These are the standards that set the levels of air pollutants in the atmosphere.

2. Emission standards. These specify maximum allowable levels of pollutants in discharge from stationary sources such as a site, process, chimney, vent, etc.

3. Chimney height standards. These ensure that the effluent is discharged at a height which will ensure that ambient air quality is kept within specified limits.

4. Fuel standards. These specify the levels of sulphur, lead and other toxic substances in the fuel. The levels of these toxic substances in the fuel will determine the levels emitted during combustion.

5. Workroom air standards. These specify threshold limit values which represent the concentration in air below which a contaminant is normally harmless on occupational exposure. These are set to protect the work force in factories.

6. Visible emission standards. These control the emission of black smoke from chimneys or vehicle exhausts.

7. Buffer Zone Standards. These specify the distance between a source of environmental nuisance or hazard and areas inhabited or frequented by the general public.

(c) Soil Degradation, Deforestation, Drought and Desertification

(i) Local farmers who use shifting cultivation, collect fuelwood and produce charcoal are mainly responsible for soil erosion and deforestation. The effects of deforestation and soil degradation are floods, siltation of reservoir dams and corrosion of hydroelectric power plants. It is recommended that:

1. Preventive action should be taken through the development of land use, crop and animal husbandry manuals for use by extension workers in order to educate and inform the local farmers on better ways of agriculture and raising livestock. This activity can be undertaken with the help of donor governments and international organizations such as FAO, UNSO, WMO, etc.

2. Agrometeorological networks should be established linking the meteorological and climatological services at national levels in order to ensure a better assessment of drought forecasting in the whole continent with the support of WMO and UNEP.

3. All governmental authorities involved in desertification, drought, reforestation and afforestation, and soil conservation should be identified and linked through a network controlled at regional centres, through which exchange of information, demonstrations or successful case studies, exchange of public awareness material to promote local participation at the grass-root level in specific programmes, and exchange of experts may be effected.

4. Alternatives must be developed and provided to the rural communities to enable the population to use non-conventional sources of energy such as biogas, solar, wind, etc. to arrest deforestation for fuelwood and charcoal. It is usually difficult to institute measures which will prevent people from say farming on hill slopes if no alternative farm land is provided.

(ii) Member States should undertake necessary control measures that will arrest deforestation and soil degradation, and reduce the effects of drought and desertification. The following are some of the measures:

1. Planting fast-growing exotic and appropriate natural forest tree species for supplying fuelwood, charcoal, fodder and shelter;

2. Utilizing the new and renewable sources of energy such as solar wind and biogas;

3. Utilizing biomass residues for energy supply such as the cotton stalks, groundnut husks, molasses, bargasse, etc.;

4. Using alternatives to fuelwood and charcoal such as kerosene, LPG, and biogas for energy needs so as to minimize the consumption of fuelwood and arrest deforestation; and

5. Modernizing the kilns used in the production of charcoal and introducing modern fuel-efficient stoves; and

(iii) It is recommended that existing national legislations should be examined with the view to incorporating important aspects of environmental protection and pollution control. The legislations which need urgent attention are those dealing with:

1. the development of water resources to ensure that the underground and surface waters are not depleted and the surface and aquifer waters are not polluted from industrial and human activities;

2. the improvement of the production of the agricultural sector and provision for the eradication of crop pests and diseases;

3. the protection of wild life;

4. controlling the use of land for agriculture, wildlife, urban and rural settlements, mining etc.; and

5. the control of importation and sale of pesticides and other agricultural chemicals. This legislation is extremely important in protecting the health of the farmers. Also restricting the use of these chemicals will reduce food and water contamination arising from misuse and improper disposal methods.

(iv) It is recommended that ECA member States should legislate against bushfires due to their destructive effects on grasslands and woodlands. Where it is really necessary to set a fire, on say pastureland, exemption permits could be provided. This control measure would improve the conservation measures taken to prevent soil erosion and degradation;

(v) Standards for agricultural produce should be established initially at regional level and later at national level or simultaneously in order to upgrade the quality of life by provision of good food free from toxic substances, and to improve the economic development of African countries whose economies depend on agriculture;

(vi) An evaluation of the feasibility of establishing roadside forestry plantations should be undertaken as a matter of urgency. If it proves viable, there could be millions of trees planted along the road network which span the whole Africa. FAO or other international agencies could be approached for financial assistance.

(d) Environmental sanitation and health

(i) Codes of practice and guides should be established to assist the public health officers and the city authorities in the maintenance of acceptable sanitation standards in the cities. It is possible with proper advice and training for people to learn the practices and habits that will upgrade the quality of their lives. These practices include general cleanliness, good ventilation and appropriate sanitation;

(ii) Research studies should be conducted on appropriate use of garbage as raw material for biogas, and for composting into manure. Popularization of these alternative sources of energy would release pressure on forests for fuelwood and charcoal;

(iii) Compilation of a register of toxic chemicals with the help of UNEP and ILO and making this information available to users of such chemicals would reduce the incidences of death arising form abuse and mishandling of pesticides and other toxic chemicals. The extention workers can play a very important role, as farmers are most vulnerable to poisoning from these chemicals;

(iv) Legislations on food, drugs and cosmetics should be enacted in order to provide appropriate infrastructures for effective food quality control and drugs registration and control. This infrastructure would be a useful tool to use against dumping of food, feed, drugs and cosmetics which have been rejected or outlawed in developed countries.

(e) Human settlements

(i) Human settlements especially in urban areas are posing very serious environmental problems. Cities provide municipal facilities such as water, sewage system, roads, electricity, health services to zones that are recognized residential areas. The slums and squatter settlements which account in some cities for up to 50% of the city population are ignored as if they do not exist;

(ii) Governments and city authorities should reverse their attitudes and begin to recognize the existence of slums and squatter settlements as an environmental problem worth their urgent attention. In order to approach this problem, governments are called to collaborate with UNCHS - Habitat and other interested international agencies in order to assess the magnitude of the problem. The following activities are necessary in order to improve shelters in these settlements and provide adequate infrastructures. It should be the objective of every government to eventually incorporate the slums and squatter settlements into recognizable zones with acceptable building structures and municipal infrastructure and facilities. Tables XXIII and XXIV indicate technical examples of a graduated or step-by-step approach to the improvement of human settlements;

(iii) Governments and city authorities are urged to recognize these slums and squatter settlements and establish a task force to perform the following activities:

1. analysing high priority human policy issues;
2. developing technical guidelines for integrated policy formulation with the help of UNCHS - Habitat; and
3. developing of effective settlement planning methods and institutional structures and procedures for urban and rural areas.

(iv) A network should be established of organizations undertaking research on indigenous building materials and techniques. Information obtained from such a network would assist in the development of recommended building codes and regulations;

(v) Building codes and regulations should be developed by national standards bodies with the assistance of UNCHS - Habitat and other interested agencies in order to upgrade the quality of human settlements. These codes and regulations should place emphasis on meeting the basic needs of the poor living in slums and squatter settlements. In tackling the basic needs of the poor, governments should aim to achieve, within the limits of available resources, the optimal improvement for the largest number of the least advantaged members of society in African cities. Thus building codes and regulations should provide for the graduated step-by-step improvement of the built environment as shown in Table XXIV.

(f) Mining

(i) Mining operations are known to be responsible for serious and sometimes severe environmental degradation and pollution. This may result from:

1. disposal to land of industrial solid and liquid waste and hazardous/ toxic wastes such as metalbearing acids/alkalis. This damages aquatic life, vegetation and the ecological balance.

Table XXIII : Improvable infrastructure standards - an example

Facility	Step I	Step 2	Step 3	Step 4
Water	Standpipes (e.g. 1 standpipe per 100 people)	Standpipes (e.g. 1 standpipe per 50 people)	Individual connections - standpipe on plot	Individual connections - multiple outlets with storage capacity
Sanitation	Pit latrines; double vault ventilation	Pour-flush acqua privy or sealed latrine	Pour-flush Septic tanks	Water carriage system
Roads	All-weather bus routes; soil removed from carriageways of access roads	All-weather bus routes; compacted-gravel or murram access roads	All-weather bus routes; sealed and chipped access roads	All-sealed all-weather footways
Drainage	Earth drains (designed for five-year storm)	Earth drains (five-year storm)	Lined inverts (five-year storm)	Lined inverts
Electricity	Minimum provision of two 60-watt bulbs	Two 100-watt bulbs; one power point	Full supply	Full supply
Street lighting	Security lights	Security lights	Normal street lighting at long intervals	Normal street lighting at shorter intervals

Table XXIV : Step-by-step technical improvement of major elements of a shelter

Major element	Step I	Step 2	Step 3
Foundation	(i) Stone pointed with line and sand (ii) Burnt brick with lime-sand mortar (iii) Soil cement and stone (iv) Cement, stone and sand[2] (v) Concrete block in cement mortar		
Floors	(i) Levelled flat stone (ii) Tamped soil, sand and lime (iii) Soil cement	(i) Cement-sand screed (ii) Concrete slab (iii) Timber	(i) Skirting and paint (ii) Plastic tiles (iii) Wood finish
Walls	(i) Soil-cement columns with clay and sand infilling (ii) Stone columns with mud-block infilling (iii) Burnt-brick columns with clay and lime infilling (iv) Wood poles with sand, clay and lime infilling	(i) Soil-cement block infilling (ii) Burnt-brick infilling (iii) Concrete-block infilling (iv) Bamboo or reed ceiling	(i) Plaster (ii) Painting and decorating
Roofs	(i) Thatch (ii) Timber (iii) Bark (iv) Bamboo (v) Reed mat (vi) Mud	(i) GI sheets (ii) Asbestos sheets (iii) Slate (iv) Tile (v) Felt paper	(i) Facia (ii) Painting and decorating
Doors and windows	(i) Softwood shutters for doors and windows	(i) Softwood louvers for windows (ii) Painting and decorating	(i) Glass louvers for windows

2. mining and smelting operations including such operations as land stripping, quarrying, formation of slag heaps, disposal of stripped soil and rocks.

(ii) Stringent legislation should be enacted requiring the mining operations to take steps to rehabilitate the areas no longer in use, controlling the disposal on land of solid waste and metal-bearing sludge, and controlling the effluent discharged into water bodies and air pollutant emissions. In addition to the application of the legislations, the annual competition such as the one being organized in Zimbabwe would provide the necessary incentives amongst the competitive candidates to be conscious of the importance of environmental protection and pollution control activities;

(iii) The ECA/ARSO Joint Project should initiate urgently a study to evaluate the feasibility of establishing industries based on recycling of wastes which presently is posing serious environmental concern, with the assistance of UNEP, UNIDO, ILO, etc. In Europe, especially Ireland such industries exist and are playing a major role in reducing environmental pollution problems whilst making profits. It should be borne in mind that reclamation of materials from waste whether it be for re-use (as was the case of Zimbabwean industries during the drought generating up to 30% water from effluent for re-use) recycling or by-product generation, is as much an integral part of solid waste management as are, for example, waste storage, collection, processing and disposal. Priority in this activity should be focussed on :

1. Recovering ferrous metals from obsolete cars, domestic refuse, prompt and process scrap, old and obsolete plant equipment and domestic appliances, etc.

2. Recovering non-ferrous metal, such as:

   - lead scrap from metal sheeting, old cable sheathing pipework, and battery scrap
   - aluminium scrap from soft drink cans, and tops, milk bottle capping, electricity cables, dudwork, pipes and tubing;
   - zinc scrap mainly from hot dip galvanizing process, die cast and waste and printers plates;
   - copper scrap from pipework, and electric cables.

3. Recycling used oil - the principal source of waste oil is used lubricating oil obtainable from automotive waste oil, industrial plant and equipment oil, etc.;

4. Recycling chemicals such as:

   - organic solvents - halogenated and non-halogenated;
   - other organics - high calorific value and low calorific value;
   - inorganics - liquids and sludges;
   - acids and alkalis - containing metals and free of metals ;
   - metal sludges - from metal containing effluents.

5. Recycling of used tyres through the following re-use options:

   - retreading for re-use as reconditioned tyres;
   - reclaiming the rubber compound as "reclaim" rubber which can be used as accumulator cases, footwear, hoses, flooring,etc.;
   - the production of rubber crumb from the rubber compound which can be used for producing 'reclaim' rubber, for carpet underlay or as a component of asphalt;
   - the conversion of worn tyres into energy and chemical products by means of pyrolysis or incineration.

6. Recovery of plastics for recycling or processing of piles for harbour works, electric cattle fences, pigsty floors, market posts for roads and car parks, etc.;

7. Recycling waste paper to produce packaging materials;

8. Incineration of waste to generate energy for heating water. Combustible waste can also be briquietted and provide an alternative for fuelwood and charcoal for cooking and space heating;

9. Recycling of glass to produce other forms of glass products such as:

   - flint glass to produce cullet for reflective microspheres;
   - amber glass to produce cullet for abrasives;
   - aggregate for terrazzo flooring;
   - other products such as : bricks, paint fillers, castings, insulating materials, reinforcing and insulating materials, etc.

(g) Environmental education, training, information, etc

(i) Establishment of a Regional Centre for Environmental Research and Training where promotional materials are developed for enhancing environmental consciousness at national, subregional and regional levels. This is where problems on interdisciplinary protection and pollution control can be investigated and solutions to current environmental problems in the fields of soil erosion, drought, deforestation, afforestation using indigenous tree species, alternative energy sources can be sought. The feasibility of the establishment of such a regional centre can be made with financial assistance from donor countries, and from UNEP, UNSO, FAO, UNESCO, etc.;

(ii) Governments are urged to establish National Committees for the Environment following the examples of Kenya and Malawi which should be entrusted with the central responsibility of coordirating at the national level all environmental activities. It is further recommended that any environmental education units in existence should be transferred to the National Committees in order to strengthen their activities and roles as national coordinators for environmental activities. Initially, these National Committees can be established through a cabinet decision and the development of legislations to provide for their activities and legal status,can be coordinated by them;

(iii) There should be organized two training seminars for the Francophone and Anglophone African countries. Such general types of seminars would enable participants to appreciate some other aspects of environmental protection and pollution control and would go a long way in sensitising African countries to being conscious of environmental protection and pollution control;

(iv) Preparation of directories of experts in different fields of environmental protection and pollution control would promote self-reliance in experts and provide a pool from which Africa may draw experts for short-term consultancies, missions and appreciation tours.

C. Co-ordination of Standardization Activities on Environmental Protection and Pollution Control

174. In order to provide for effective co-ordination of environmental standards, development and implementation, there should be clearly defined roles and liaisons with the relevant institutions at regional and national levels. The lack of such liaisons may lead to never ending conflicts especially at national level between national standards bodies and the relevant authorities charged with the central responsibility for overall co-ordination of environmental matters. The following interactions as shown in Fig. IV are recommended in order to ensure effective and efficient management of standardization activities on environmental protection and pollution control at national and regional levels.

(a) At regional level the development of regional standards should be the central responsibility of ARSO through ARSO/TC9 with inputs from:

(i) National Standards Bodies to ensure maximum acceptability of regional standards at national level;

(ii) national co-ordinating committees, ministries of the environment, departments of the environment or related departments/ministries which cover environmental activities to ensure that the regional standards promulgated comply with national policy and legislation on the environment; and

(iii) the subcommittee on environmental standards of the ECA Joint Intergovernmental Regional Committee on Human Settlements and Environment (IGRC/HUS/ENV) to ensure that the regional standards comply with environmental policies as agreed by the ECA Conference of Ministers affecting the African continent.

(b) At national level where conflict of interest is likely to develop, it is essential that the:

(i) National Standards Bodies are charged with the central responsibility for developing national standards for implementation by self or other relevant authorities. This should be clearly spelt out in the legislation establishing National Standards Bodies;

(ii) National environmental machineries, which include ministries, departments, commissions, councils or academies, liaise with the National Standards Bodies in the development of environmental standards and act as a principal participants in any technical committee work of National Standards Bodies.

(c) The role of National Standards Bodies should be that of developing environmental standards and promoting the implementation for environmental protection whilst that of national environmental machineries should be to enforce them. If the roles of the two major institutions are clearly defined effective co-ordination of standardization activities on environmental protection and pollution control will occur against a background of mutual understanding and respect of each other's role.

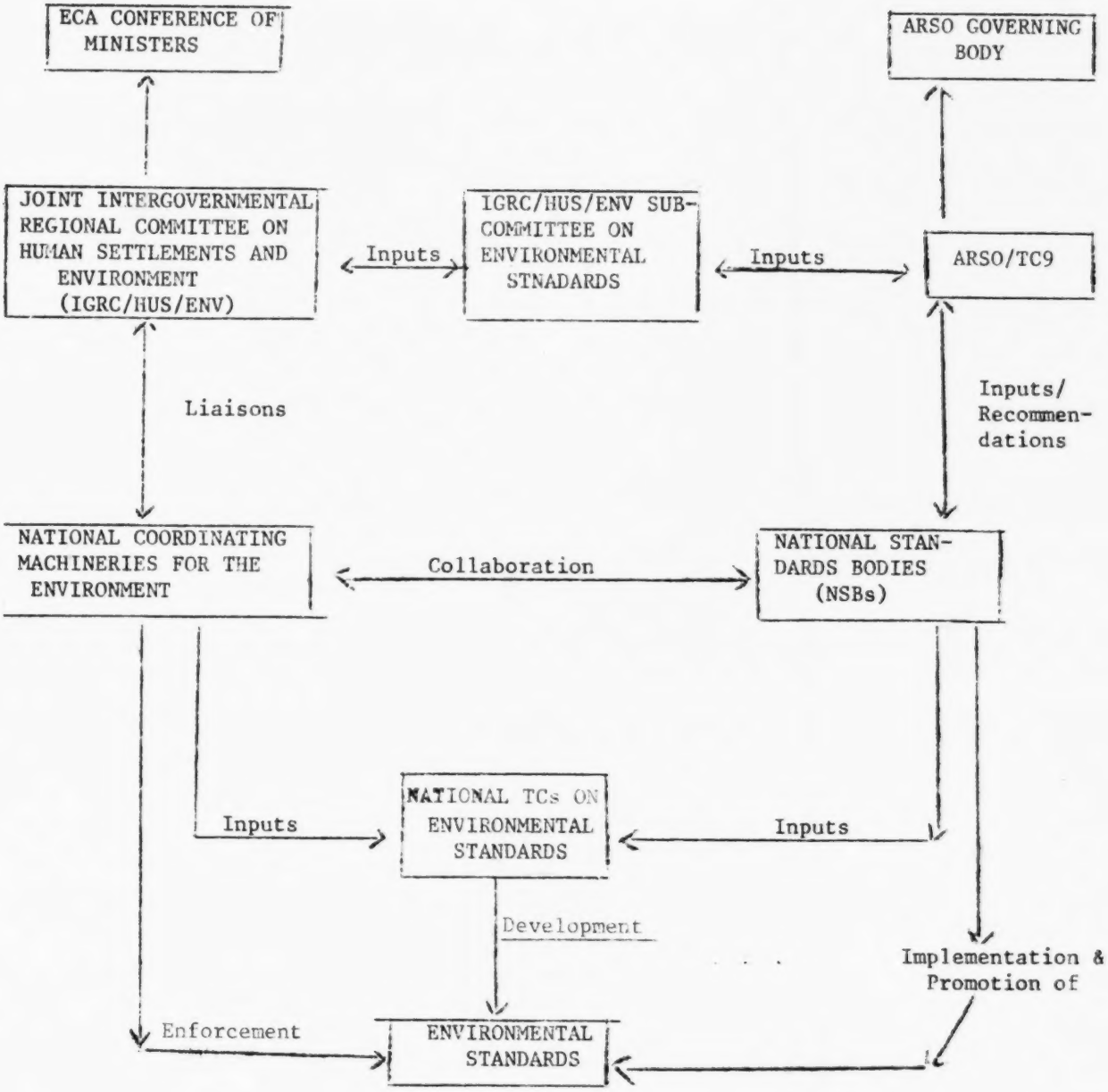

Fig. IV: Co-ordination of Standardization Activities on Environmental Protection and Pollution Control.

LIST OF COUNTRIES AND INSTITUTIONS VISITED

A INSTITUTIONS VISITED

1. Mr. Zawdu Felleke
   Secretary General
   African Regional Organization for Standardization (ARSO)
   P.O. Box 5763
   Nairobi, KENYA

2. Dr. G. Y. Ablijah
   Technical Officer
   ARSO
   P.O. Box 5763
   Nairobi, KENYA

3. Mr. P. Garau
   Officer-in-Charge
   Settlements, Planning and Policies Section
   Research and Development Branch
   UNCHS - Habitat
   P.O. Box 30030
   Nairobi, KENYA

4. Mr. Mario Piche
   Head
   Infrastructure, Research and Development
   UNCHS - Habitat
   P.O. Box 30030
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5. Dr. Gehan S. Sinnatamby
   Expert and Specialist
   Water Supply, Sanitation and Solid Waste
   UNCHS - Habitat
   P.O. Box 30030
   Nairobi, KENYA

6. Dr. M.D. Gwynne
   Director
   Global Environmental Monitoring System (GEMS)
   UNEP
   P.O. Box 47074
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B ETHIOPIA (13 - 16 March 1985)

7. Mr. Alemayehu Gizaw
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   Ethiopian Standards Institution
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   Addis Ababa

8. Mrs. Fettlework Kesela
Standards Officer (Food and Nutrition)
Ethiopian Standards Institution
P.O. Box 2310
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9. Miss Yesuswork Bekele
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10. Mr. Kassa Kinde
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Environmental Health Department
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11. Mr. Sheferaw Begashaw
Chief Industrial Chemist
Department of Industrial Chemistry
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12. Mr. Kamal Zakaria
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13. Mr. Hailu Negero
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14. Mr. Dagnachew Asfew
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C. EGYPT (18 - 21 March 1985)

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16. Dr. Anwar El-Tawil
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17. Dr. Hamdy El-Dossokey
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18. Mr. A. Kafafi
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19. Eng. Mohamed M. Kamel Ismail
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20. Dr. Abdel M.A.R. Ibrahim
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Meteorological Authority
Cairo

21. Dr. Adel A. Halim
Chief
Numerical Weather Prediction Division
Meteorological Authority
Cairo

22. Dr. Anwar El-Dib
Professor in water Pollution
National Research Centre
Dokki
Cairo

23. Dr. Fatma El-Gohary
Research Professor
Head of Water Pollution Control Laboratory
National Research Centre
Dokki
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24. Mr. Gihad Ahmed Hassan
Chemist
Water Supply Organization
Cairo

25. Dr. Ezzat Abbas
Director of Research
Water Supply Organization
Cairo

26. Dr. Mahmoud Labib
Director of Research
Greater Cairo Sewage and Sanitation Drainage Organization
Cairo

27. Dr. Ezzat M. Helwa
Director General
Environmental Health Department
Ministry of Health
Cairo

28. Dr. Ahmed A. El-Gamal
1st Under Secretary for Health
Ministry of Health
Cairo

D. ZIMBABWE (25 - 28 March 1985)

29. Mr. J.E. Cobb
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30. Mr. H.K. Sunderland
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UNITED NATIONS ECONOMIC COMMISSION FOR AFRICA (UNECA)

Social Development, Environment and Human
Settlements Division, Environment Section

Survey of existing environment standards in Africa

This questionnaire is designed to provide up-to-date information regarding the issues involved in the development and management of environmental standards in Africa.

Structure of the questionnaire

The questionnaire comprises the following five (5) elements:-

I. General Information
II. Existing environmental management and monitoring infrastructure
III. Air quality standards
IV. Drinking water quality standards
V. Standards to prevent ecological degradation

The questionnaire

I. General Information:

(a) Name of the country _____

(b) Name and address of agency or ministry responding _____

_____

_____

(c) Name and title of the respondent _____

_____

_____

II. Existing environmental management and monitoring infrastructure:

(a) Do you have an agency or organization responsible for co-ordinating environmental matters or issues in your country?

Yes ☐ No ☐

If yes, what is it called?

_____

_____

(b) Has your country established pollution standards for:

(a) drinking water Yes ☐ No ☐

(b) industrial waste disposal Yes ☐ No ☐

(c) air pollution Yes ☐ No ☐

If you have these standards kindly attach one copy to this questionnaire? attached Yes ☐ ☐

(c) Do you have laboratory facilities to monitor environmental standards in your country?

Yes ☐ No ☐

If yes, state name of responsible institution(s) and how many staff does it have?

_____

_____

(d) Do you have training institutions geared to developing manpower for the control and management of environmental degradation?

Yes ☐ No ☐

If yes, what is the name of the institution?

_____

(e) Do you have a single focus point which is responsible for the regulation or control of environmental standards?
(e.g. National Board of Standards)

Yes ☐ No ☐

If yes, what is it called and how many staff does it have?

_____

_____

III. Air quality standards

(a) Do you consider air pollution in your country as a problem at this time?

Yes ☐ No ☐

(b) What percentage of the air pollution in your country would you say is the result of the following sources?

Source	Percentage
(a) Transportation (exhausts)	
(b) Combustion of fuel including generation of electricity	
(c) Industrial activities	
(d) Solid waste disposal	

(c) Has your country established air quality standards? If yes, kindly attach a copy with this survey.

Yes ☐ No ☐

IV. Drinking water quality standards:

Do you have laboratory facilities to conduct the following test as indicators of water pollution in your country:

(a) Bacteriological Examination (which is the routine surveillance of water supplies).

Yes ☐ No ☐

(b) Virological Examination

Yes ☐ No ☐

(c) Biological Examination

Yes ☐ No ☐

(d) Radiological Examination

Yes ☐ No ☐

(e) Physical and chemical examination

Yes ☐ No ☐

(f) Has your country established drinking water quality standards?

Yes ☐ No ☐

(g) Has your country identified the sources of water pollution?

Yes ☐ No ☐

(h) If yes, what are the major sources of water pollution in your country?

_____

_____

V. Standards to prevent ecological degradation:

(a) Do you have any rules, regulations or standards relating to deforestation and reforestation?

Yes ☐ No ☐

If yes, please state title and attach copies _____

_____

(b) Do you have any rules or regulations or standards relative to mining and rehabilitation of landscape of mining areas?

Yes ☐ No ☐

If yes, please state title and attach copies _____

_____

(c) Are there any mining activities in your country?

Yes ☐ No ☐

If yes, what are they _____

_____

(d) Are there any major timber corporations in your country?

Yes ☐ No ☐

If yes, how many and what are their capacity?

_____

_____

(e) Do you have any rules, regulations or standards regarding fertilizer and pesticides usages for agricultural purposes in your country?

Yes ☐ No ☐

If yes, please state titles and attach copies _____

_____

LIST OF RECOMMENDED NATIONAL AND REGIONAL STANDARDS OF THE ENVIRONMENT

A. Water quality

1. Quick and hydrated limes used for drinking water purification
2. Chlorinated lime for purification and sterilization of potable and drainage water
3. Ferrous sulphate for purification of potable and drainage water
4. Aluminium sulphate (Alum) for purification of potable water
5. Water quality-Sampling-Guidance on the design of sampling programmes
6. Water quality - Vocabulary
7. Methods of sampling and tests(physical and chemical) for water used in industry
8. Methods of sampling and test for microbiological examination of water used in industry
9. Quality tolerances for water for fermentation industry
10. Quality tolerances for water for pharmaceuticals
11. Quality tolerances for water processed food industry
12. Quality tolerances for water for tanning industry
13. Quality tolerances for water for pulp and paper industry
14. Quality tolerances for water for textile industry
15. Methods of test for routine control for water used in industry

B. Effluents, convenyance, and treatment

16. UPVC Sewer and Drain Pipes and Fittings
17. Standard method for sampling of drainage water for chemical analysis
18. Guide for treatment of effluents of electroplating industry
19. Standard specification for Effluents
20. Glossary of terms relating to water, sewage, and industrial effluents
21. Methods of sampling and test for sewage effluents
22. Tolerance limits for industrial effluents discharged into inland surface waters: (general limits, distillery industry, tanning industry, electroplating industry, etc.)
23. Tolerance limits for industrial effluents discharged into public sewers
24. Tolerance limits for industrial effluents discharged on land for irrigation purposes
25. Tolerance limits for inland surface waters subject to pollution
26. Methods of sampling and test for industrial effluents
27. Guide for treatment of effluents of pulp, paper and board industries
28. Guide for treatment of effluents of cane sugar industring
29. Guide for treatment and disposal of effluents of tanning industry
30. Code of practice for waste stabilization ponds (facultative type)
31. Bio-assay methods for evaluating acute toxicity industrial effluents and waste waters to fish
32. Tolerance limits for sewage effluents discharged into inland surface waters

33. Guidance for treatment and disposal of steel plant effluent
34. Code of practice for the design and cesspools
35. Sewage systems
36. Sewer pipes, asbestos cement or earthenware

C. Air quality

37. Determination of gaseous sulphur compounds in ambient air-sampling equipment
38. Determination of mass concentration of sulphur dioxide in ambient air-Thorin Spectophotometric method
39. General Aspects - Vocabulary, units of measurements, etc.
40. Methods for measurement of air pollution
    - Dustfass
    - Sulphur Dioxide
    - Radioactivity (particulate)
    - Suspended matter
    - Sampling of gaseous pollutants
    - Nitrogen Oxides
    - Hydrogen Sulphide
    - Oxidants
    - Polynuclear aromatic hydrocarbons in air particulate matter
    - Mass Concentration of particulate matter in atmosphere
    - Continuous analysis and automatic recording of the oxidant content of the atmosphere
41. Standard method for determining smoke point in petroleum products

D. Soil and human contamination

42. Specification for Materials for soil stabilization
43. Code of practice for the use and disposal of Acaricides (cattle dips)
44. Code of practice for the handling, storage, and disposal of pesticides and their containers on farms and small-holdings
45. Code of practice for the handling, storage, and disposal of pesticides and used pesticide containers
46. Specification for protective apparel for use against pesticides
47. Standard methods for the evaluation of pesticides
48. Code of practice for the safe use of household insecticides and remedies
49. Code of practice for the application of fumigants
50. Guide for handling cases of pesticide poisoning (first aid measures and symptoms, diagnosis and treatment)
51. Code of practice for fumigation of agricultural produce (methyl bromide, Ethylene dibromide, Aluminium phosphide, carbon tetrachloride and ethylene dichloride mixture)
52. Methodfor testing efficacy of fumigation for disinfestation of grains in domestic bins
53. Method of test for determination of BHC residues in food grains

54. Method of test for determination of DDT residues (Food grains and their milled products)
55. Method of test for determination of Malathion residues (Cereals and oil seeds)
56. Method of test for determination of Parathion residues

FIG. I MAJOR MINERAL RESOURCES (1977)

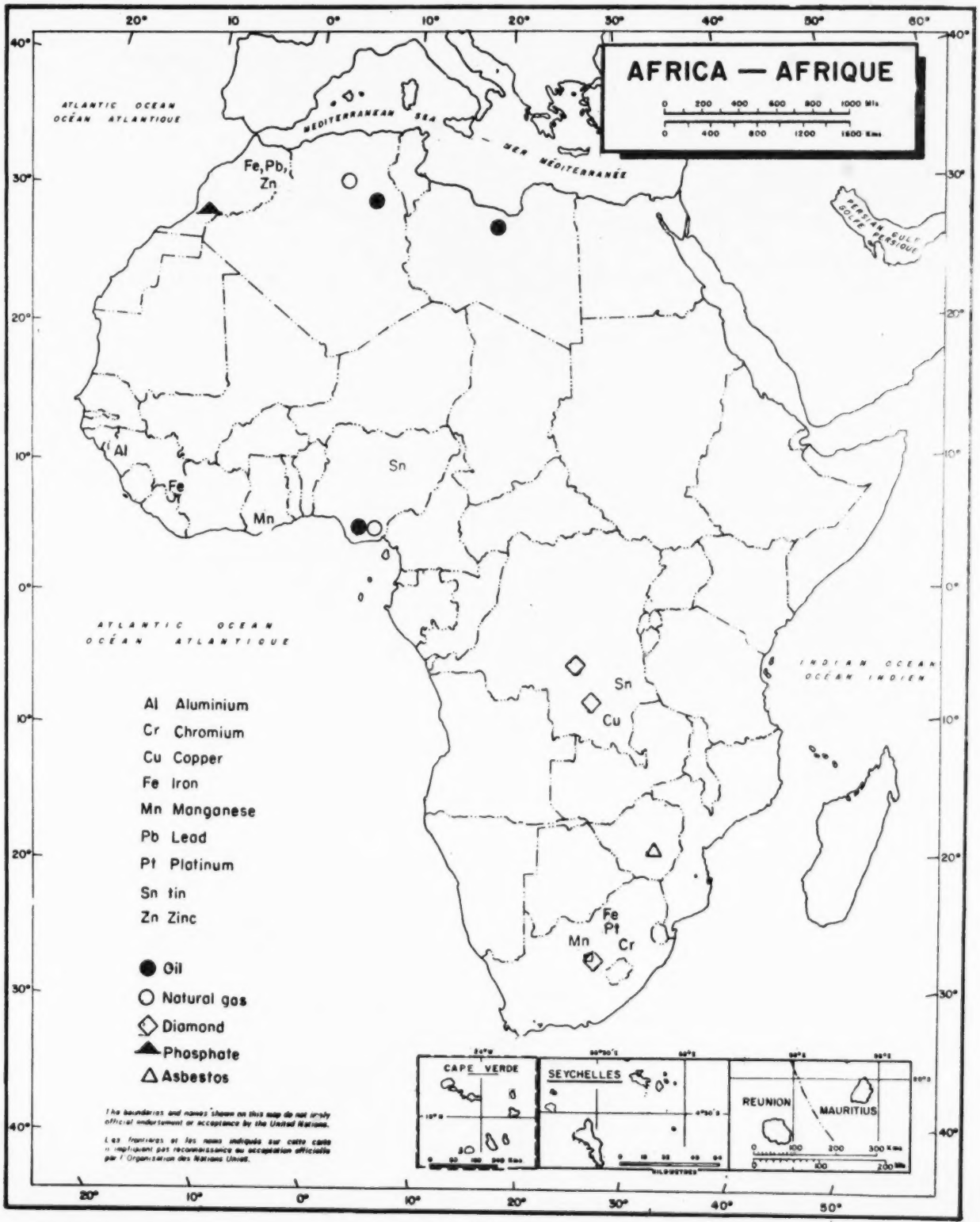

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Fig I